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HISTORY AND FREQUENCY OF SMALLPOX VACCINATIONS AND CASES IN 9,000 FAMILIES

Based on Nation-wide Periodic Canvasses, 1928–31 [1]

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Almost from the time of its introduction by Jenner in 1796, vaccination against smallpox has been an accepted procedure in the prevention of the disease. Although widely advocated by private physicians and health departments and extensively practiced in this and other countries, no considerable mass of data relating to the frequency of vaccination has heretofore been assembled. Data recently collected make possible a rough estimate of the extent of vaccination in the United States.

I. SOURCE AND CHARACTER OF DATA

In the study of illness in canvassed white families in 130 localities in 18 States [2] that was made by the Committee on the Costs of

[1] From the Office of Statistical Investigations, U. S. Public Health Service.

This is the seventh of a series of papers on sickness and medical care in this group of families (1–6). The survey of these families was organized and conducted by the Committee on the Costs of Medical Care; the tabulation was done under a cooperative arrangement between the Committee and the Public Health Service. Committee publications based on the results deal primarily with costs and Public Health Service publications primarily with the incidence of illness and the extent and kind of medical care, without regard to cost. As costs are meaningless without some knowledge of the extent and nature of the service received, there is inevitably some overlapping. The committee staff, particularly Dr. I. S. Falk and Miss Margaret Klem, cooperated in the tabulation of the data.

Special thanks are due to Dr. Mary Gover, who assisted in the analysis, to Miss Lily Vanzee, who was in immediate charge of tabulating the data, and to other members of the statistical staff of the Public Health Service, particularly Dr. W. M. Gafafer and Mr. R. H. Britten, for advice and assistance in the preparation of the study.

[2] The 18 States sampled and the number of canvassed families were: California, 890; Colorado, 386; Connecticut, 100; District of Columbia, 99; Georgia, 544; Illinois, 463; Indiana, 494; Kansas, 301; Massachusetts, 287; Michigan, 329; Minnesota, 224; New York, 1,710; Ohio, 1,148; Tennessee, 212; Virginia, 412; Washington, 551; West Virginia, 318; and Wisconsin, 290. Further details about the distribution of the canvassed population are included in a preceding paper (1).

Medical Care and the United States Public Health Service, all service received from physicians and other practitioners was recorded, whether for illness, immunization, physical examination or other reason. The records of vaccination against smallpox for all persons in the observed population afford data on the frequency of this procedure during a 12-month period covered by periodic canvasses; information was also obtained on the history of smallpox vaccination and cases at any time prior to the study. These records make available data on the status of the observed population with respect to immunity to smallpox acquired by vaccination or by an attack of the disease. Because the probability of vaccination prior to a given date is influenced greatly by the number of years the person has lived, the histories in this study are considered for persons of specific ages.

The composition and characteristics of the group of 8,758 families who were kept under observation for 12 consecutive months in the years 1928–31 have been considered in some detail in the first report in the series (1). These families, including a total of 39,185 individuals, represented all geographic sections. Every size of community was included, from metropolitan districts to small industrial and agricultural towns and rural unincorporated areas. The observed group was similar to the general population with respect to age and sex composition, percentage native born, and percentage married. With respect to income, the distribution was reasonably similar to the estimated distribution of the general population of the United States at the time of the survey.

Every locality included had a visiting nurse and a local health department or some other agency employing a visiting nurse. This condition is inherent in the method of the study which required, among other things, that local visiting nurses from health departments or other agencies make the canvasses of the homes to secure the data. Such communities may be better vaccinated than those without health organizations. On the other hand, the record of vaccinations here considered may be less complete than could be obtained by the examination and questioning of individuals. In this study the report for the whole family was made by the housewife or some other adult female; however, the canvasses were periodic and corrections or additional information could be secured at subsequent visits.

II. HISTORY OF VACCINATION AND CASES AT BEGINNING OF STUDY

VARIATION WITH AGE AND SEX

Figure 1 shows for specific ages the proportion of individuals (*a*) who had been vaccinated at any time, (*b*) who had been vaccinated within the preceding 7 years, and (*c*) who had been attacked by smallpox at

any time (table 1). At no age did more than 5 percent of the individuals give a history of an attack of smallpox. The total population with any known present or past immunity to smallpox, comprising about 70 percent of the adults, consists almost entirely of the vaccinated, with only a small proportion with a history of a case.

TABLE 1.—*History of smallpox vaccinations and cases among persons of specific ages of each sex—canvassed white families in 18 States* [1]

Age in years	Both sexes: Percentage of persons with history of— Vaccination or case at any time	Vaccination at any time but no case	Vaccination within 7 years	Vaccination within 7 years or case at any time	Case at any time	Total number of persons considered [2]	Percentage of vaccinations that were done within 7 years	Percentage of persons with history of— Vaccination at any time but no case: Male	Female	Case at any time: Male	Female	Total number of persons considered [2]: Male	Female
All ages	57.4	54.4	23.6	26.6	3.02	37,859	43	53.9	54.7	2.95	3.15	18,573	19,286
Under 6 months	2.1	2.1	2.1	2.1	------	529	100						
6–11 months	4.9	4.9	4.9	4.9	------	390	100	5.9	5.0	.11	------	915	893
1	7.9	7.8	7.8	7.9	.11	889	100						
2	12.2	11.9	11.9	12.2	.29	1,044	100	12.8	11.6	.37	.29	1,092	1,034
3	12.9	12.5	12.5	12.9	.40	1,082	100						
4	20.5	20.1	20.1	20.5	.44	1,133	100	23.6	23.7	.53	.52	1,140	1,164
5	27.7	27.1	27.1	27.7	.60	1,171	100						
6	46.0	44.9	44.9	46.0	1.12	1,159	100	50.0	52.7	1.18	.70	1,183	1,145
7	58.5	57.7	57.7	58.5	.77	1,169	100						
8	58.4	57.1	56.6	57.8	1.25	1,204	99	57.6	58.2	1.39	1.76	1,076	1,135
9	60.8	58.8	55.9	57.9	1.98	1,007	95						
10	64.3	61.6	56.9	59.5	2.69	1,077	92						
11	63.3	60.9	55.5	57.9	2.44	901	91						
12	68.6	65.9	54.6	57.3	2.73	915	83	62.5	64.4	2.35	2.96	2,298	2,267
13	67.0	63.7	47.0	50.4	3.26	829	74						
14	67.6	65.5	40.4	42.5	2.14	843	62						
15	69.8	65.0	34.7	39.5	4.81	686	53						
16	68.0	65.7	32.3	34.6	2.26	708	49						
17	66.1	62.3	26.9	30.7	3.76	585	43	64.9	64.8	3.74	4.02	1,524	1,517
18	69.8	65.8	24.5	28.5	4.00	575	37						
19	70.0	65.1	27.8	32.7	4.93	487	43						
20–24	70.5	66.5	18.9	22.9	4.03	2,110	28	64.2	68.1	4.38	3.77	891	1,219
25–34	69.1	65.0	12.2	16.3	4.12	5,626	19	66.6	63.8	3.47	4.61	2,394	3,232
35–44	68.4	63.8	10.7	15.3	4.62	5,927	17	65.4	62.1	4.23	5.02	2,977	2,950
45–54	66.3	61.6	9.1	13.8	4.65	3,353	15						
55–64	65.3	61.8	7.9	11.4	3.48	1,466	13	58.8	61.7	4.80	3.66	3,083	2,730
65 and over	56.8	52.7	5.1	9.2	4.12	994	10						

[1] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

[2] A few individuals known as to case history were unknown as to vaccination history (140 out of the 37,859 persons); the rates in every instance are based on the known only. Vaccinations of unknown time (5 percent of total) were assumed to be distributed like those of known time.

Only one-fifth of the 4-year-old children had been vaccinated. Entrance into school at 5 and 6 years marks the age of many vaccinations; the proportion vaccinated rises from 20 percent at 4 years to 58 percent at 7 years of age. After 7 years the curve rises gradually to a maximum of about 65 percent for persons above 15 years who had been vaccinated and about 70 percent who had been vaccinated or had suffered an attack of smallpox.

The duration of a specific degree of immunity following vaccination varies considerably in different individuals; likewise the average duration depends to a large extent upon the standard or degree of immunity that is accepted as indicating an immune person (13). There is no general agreement as to how often revaccination should be done; the intervals recommended vary from 2 to 10 years, the traditional dictum being to revaccinate every 7 years. Immunity after an attack of smallpox is usually considered to last throughout life.

Figure 1 shows what proportion of persons of different ages gave a history of a vaccination within 7 years of the date of the interview or had suffered an attack of smallpox at any time in their lives. From a maximum of 60 percent at 10 years of age this curve declines rather rapidly to 23 percent at 20 to 24 years and to 16 percent at 25 to 34 years. After this age the decline is less rapid, the percentage being

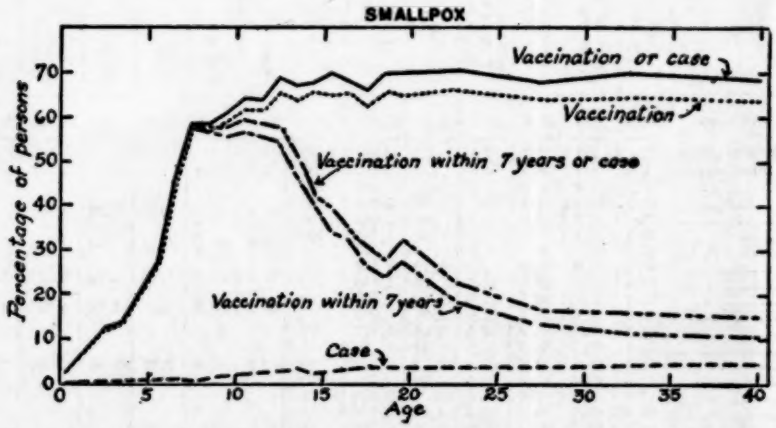

FIGURE 1.—Percentage of persons of specific ages who had been vaccinated (a) at any time, (b) within 7 years, and (c) percentage who had suffered an attack of smallpox—8,758 canvassed white families in 18 States, 1928-31.

14 at 45 to 54 years, but more than a third of this 14 percent is represented by histories of smallpox cases, with only 9 percent who had actually been vaccinated within 7 years. In other words, a small proportion of people, perhaps 10 percent, are revaccinated at intervals of 7 years or less; the great majority of children vaccinated at the time of entrance into school are never revaccinated.[3]

Considering all ages, 56.9 percent of the males and 57.9 percent of the females gave a history of vaccination or a case of smallpox at some time in their lives. These percentages were made up of 53.9 and 54.7 percent for males and females, respectively, who had been vaccinated but had not suffered attacks, and 3.0 and 3.2 percent of males and females, respectively, who gave a history of an attack of the disease.

[3] To change the period since vaccination from 7 years as here presented to some lesser interval, as 5 years or 2 years, would give a curve that declines more rapidly with age than the one shown in figure 1, and in the older ages it would approach even closer the percentage of persons who had been attacked by the disease.

These data are shown for specific ages in table 1 and figure 2. It appears that there are no consistent or significant differences between the sexes with respect to these items, with the possible exception of a higher history of smallpox cases for females in the two age groups from 25 to 44 years (table 1). The excess for females may be due to the fact that the women (housewives) were usually the informants and would know their own history better; but another possible factor is the added risk of an attack, because women of these ages usually nurse others in the household who contract smallpox.

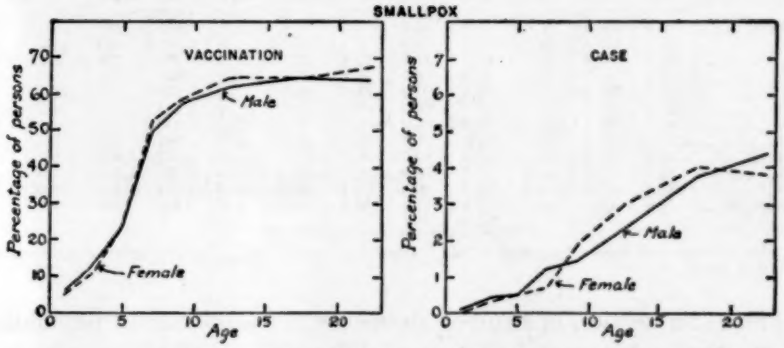

FIGURE 2.—Percentage of males and females of specific ages (a) who had been vaccinated and (b) who had suffered an attack of smallpox—8,758 canvassed white families in 18 States, 1928–31.

VARIATION OF VACCINAL STATUS WITH SIZE OF CITY AND GEOGRAPHICAL LOCATION

The proportion of persons who had been vaccinated might be expected to vary greatly from one community to another, depending upon State laws and local regulations and practices regarding vaccination.

Cities and rural areas.—In figure 3 the proportions vaccinated at different ages have been plotted for cities of various sizes and for rural areas (table 2). The rise of the curve to a maximum level by 15 to 20 years of age is characteristic of each size of city, but the sharpest increases come earlier in large cities than in rural places. Also, there is considerable difference in the height of the level which represents the proportion of adults who had been vaccinated against smallpox at some time in their lives. In the rural areas included in the survey, slightly more than 40 percent of the adults gave a history of a vaccination; in the cities with populations of 100,000 or more, about 85 percent of the adults had been vaccinated—more than twice the percentage in rural areas. The smaller cities and the towns fall logically between these two extremes, the curve for small cities reaching a maximum of 64 percent and that for towns under 5,000 a maximum of 58 percent.

TABLE 2.—*History of smallpox vaccinations among persons in cities of various sizes and in rural areas—canvassed white families in 18 States* [1]

Age in years	Percentage of persons with a history of—								Total number of persons considered			
	Vaccination or case at any time				Vaccination at any time but no case							
	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas
All ages	73.0	54.0	49.3	38.5	71.5	50.5	45.0	34.2	14,089	9,531	7,442	6,797
Under 2	8.1	3.7	6.0	1.9	8.1	3.5	6.0	1.9	677	537	331	263
2–3	19.3	9.6	10.5	5.8	18.9	9.1	10.3	5.8	747	584	448	347
4–5	37.1	22.9	15.5	12.7	36.7	22.4	15.3	11.5	758	639	503	404
6–7	75.4	49.3	37.2	26.6	74.6	48.6	35.9	25.5	838	586	523	381
8–9	81.7	58.7	45.3	34.4	80.9	56.7	42.7	33.0	772	589	424	426
10–14	85.0	66.5	54.7	45.7	84.0	64.0	50.5	41.6	1,577	1,105	907	976
15–19	86.1	67.5	63.3	48.2	84.9	64.2	56.4	42.0	1,035	757	568	681
20–24	87.2	65.4	63.1	46.3	85.6	60.2	57.3	40.0	863	504	360	383
25–34	82.7	62.5	62.7	47.9	80.5	55.9	57.8	43.6	2,362	1,428	1,094	742
35–44	82.2	67.1	61.8	45.5	79.9	61.5	54.8	39.5	2,305	1,509	1,134	979
45–54	83.4	63.8	57.5	45.7	80.9	59.4	50.5	38.9	1,248	803	629	673
55 and over	74.9	60.5	60.2	42.9	72.9	56.8	56.0	36.6	907	490	521	542

[1] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

The lower section of figure 3 shows for the same size of population groups the proportion of persons of different ages who gave a history of an attack of smallpox (table 3). The order of the curves is here approximately reversed; the relatively well vaccinated cities of 100,000 or over had the smallest proportion of persons with smallpox histories, 1.5 percent for all ages, with a maximum of 2.5 percent for persons 45 to 54 years of age. The curve for smaller cities (5,000–100,000) is below those for towns and for rural areas from about 10 to 25 years, but is at approximately the same level for other ages.

TABLE 3.—*History of smallpox cases among persons in cities of various sizes and in rural areas—Canvassed white families in 18 States* [1]

Age in years	Percentage of persons with history of a case at any time				Number of persons with history of a case at any time				Total number of persons considered			
	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas
All ages	1.51	3.49	4.26	4.30	213	333	317	292	14,089	9,531	7,442	6,797
Under 5	.22	.35	.10	.37	4	5	1	3	1,799	1,420	1,033	815
5–9	.75	1.19	1.59	1.19	15	18	19	12	1,993	1,515	1,196	1,006
10–14	.95	2.53	4.19	4.10	15	28	38	40	1,577	1,105	907	976
15–19	1.16	3.30	6.87	6.17	12	25	39	42	1,035	757	568	681
20–24	1.62	5.16	5.83	6.27	14	26	21	24	863	504	360	383
25–34	2.20	6.58	4.94	4.31	52	94	54	32	2,362	1,428	1,094	742
35–44	2.26	5.57	6.97	6.03	52	84	79	59	2,305	1,509	1,134	979
45–54	2.48	4.36	7.00	6.84	31	35	44	46	1,248	803	629	673
55 and over	1.98	3.67	4.22	6.27	18	18	22	34	907	490	521	542

[1] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

Considering all ages, 3.5 percent of people living in the smaller cities gave a history of a case of smallpox, as against 4.3 percent for both the towns under 5,000 and the rural areas. Throughout the various ages the curves for towns under 5,000 and for rural unincorporated areas are quite close together, suggesting that fewer vaccinations in the rural population may be compensated for by less contact among these families. Another possible factor is a greater frequency of cowpox in the farm population, with resulting immunity to smallpox. Unrecognized smallpox cases would similarly result in immunity without a reported history of an attack or vaccination. Many of the towns under 5,000 are agricultural villages in the center of rural areas, and their disease histories might be expected to be similar.

TABLE 4.—*Comparison of the history of smallpox vaccination among preschool children in the present study in 18 States with the results of the White House conference study (17) in 156 cities in 45 States and 597 counties in 42 States*

	Percentage of children of the given ages who had been vaccinated at any time					
	Under 1	1	2	3	4	5
18 States study:						
Cities of 100,000 and over	4.8	11.3	19.3	18.5	30.4	42.8
Cities 5,000–100,000	2.7	4.6	8.4	9.7	18.5	25.9
White House conference study (17, pp. 49, 174), urban (145,720 preschool children in 156 cities mostly over 50,000):						
All 156 cities combined	3.4	11.1	16.7	20.8	28.4	43.8
Median of the 156 cities	0	3	7	11	17	30
18 States study:						
Towns under 5,000	2.7	8.8	9.5	11.0	13.8	16.9
Rural areas	1.4	2.4	3.6	7.7	11.2	11.7
White House conference study (17, p. 175), rural (37,439 preschool children in towns under 2,500 and on farms)	.6	2.3	4.8	7.6	11.4	17.9

The percentages of preschool children in cities of different sizes that had been vaccinated may be compared with those found by Palmer, Derryberry, and Van Ingen (17) in the White House Conference report, covering a large number of cities and counties throughout the country. The results in the two studies (table 4) are reasonably comparable, and the indicated differences between urban and rural vaccination practices are of the same order of magnitude.

No large body of similar data is available for comparison with results for the school ages. In the absence of more recent records, comparison may be made with vaccination histories as recorded in physical examinations of school children made about 1920 by medical officers of the United States Public Health Service (table 5). The percentage of children of given ages who had been vaccinated varied a great deal from locality to locality, presumably because of differences in vaccination laws, regulations, and practices. In the 14 localities where school children were examined, the proportion of 12- and 13-year-olds who had been vaccinated varied from 25 to 98 percent, as

against 44 percent in rural areas to 86 percent in large cities included in the present family survey, with individual communities varying more than these limits indicate.

TABLE 5.—*Comparison of the history of smallpox vaccination among children of the school ages as reported in canvasses of families in 18 States (1928–31) and as determined by physical examinations of children in certain localities (1917–23)*

Locality and populations in 1920 (approximate time of school examinations)	Number of children observed, all ages, 6–16	Percentage of children of specific ages who had been vaccinated at any time						
		All ages, 6–16	6	7	8–9	10–11	12–13	14–16
Canvass of families in 18 States:								
Cities of 100,000 or over	3,645	81.1	67.1	81.5	80.9	81.7	85.6	84.3
Cities 5,000–100,000	2,636	59.3	42.6	54.5	56.7	63.5	64.9	65.6
Towns under 5,000	2,125	46.2	32.0	40.1	42.7	49.5	50.0	55.3
Rural areas	2,092	37.3	20.3	30.9	33.0	37.7	43.6	44.9
Examination of school children in certain localities:								
Cotton-mill villages near Spartanburg, S. C. (village)	989	19.7	3.9	10.8	17.0	22.5	26.2	33.3
New Castle County, Del. (rural and village)	631	31.2	17.6	28.3	24.6	23.3	35.9	43.7
Spartanburg, S. C. (22,638)	1,443	52.2	28.6	39.0	51.4	57.7	56.5	56.7
Fort Worth, Tex. (106,482)	3,570	55.1	31.2	44.7	54.9	57.3	58.9	54.1
Nassau County, N. Y. (rural and village)	703	64.3	31.6	45.8	53.5	70.1	78.1	76.8
Leavenworth, Kans. (16,912)	1,767	72.3	67.7	67.8	71.5	73.2	75.1	74.6
Louisville, Ky. (234,891)	2,794	79.9	58.6	64.1	74.2	83.0	86.1	89.2
Frederick County, Md. (rural and towns up to 11,066)	3,984	86.1	70.0	80.4	85.0	87.6	88.4	91.3
Hampton, Va. (6,138)	1,072	87.8	80.0	87.0	87.2	88.2	89.8	86.7
Hattiesburg, Miss. (13,270)	593	91.2	86.4	90.6	93.7	88.7	92.8	92.0
Charlotte, N. C. (46,338)	3,951	91.6	84.0	92.4	92.2	91.4	92.8	91.4
Petersburg, Va. (31,012)	1,682	93.9	96.8	82.6	93.4	95.9	95.5	96.0
Greenville, S. C. (23,127)	711	94.0	98.5	95.9	94.5	93.2	93.2	90.9
Waco, Tex. (38,500)	3,632	95.6	91.3	96.2	95.3	94.8	97.5	94.5

Geographic location.—The 18 States in which the surveyed population lived may be divided into 4 geographic sections, the *Northeast* (New York, Massachusetts, Connecticut), representing the New England and Middle Atlantic States, the *North Central* (Illinois, Ohio, Michigan, Indiana, Wisconsin, Minnesota, Kansas), representing the North Central States, the *South* (District of Columbia, Virginia, West Virginia, Tennessee, Georgia), representing the South Atlantic and South Central States, and the *West* (Colorado, California, Washington), representing the Mountain and Pacific States.[4]

In figure 4 the vaccination history has been plotted for each of the 4 geographic sections (table 6). Curves of the kind under consideration in this paper are cumulative in nature, because they give the percentage that had ever been vaccinated. In the absence of change in the annual frequency of vaccinations, one would expect, apart from chance fluctuations, a continuously rising curve. The hump at 8 to 9 years in the curve for the South suggests that in this section more vaccinations have been made in recent years than 10 or 15 years ago.

[4] Further details about the number of families from each State and each class of city are included in a previous paper (1).

TABLE 6.—*History of smallpox vaccinations among persons in 4 geographic sections* [1] *of the United States, canvassed white families in 18 States* [2]

Age in years	Percentage of persons with a history of—								Total number of persons considered			
	Vaccination or case at any time				Vaccination at any time but no case							
	North-east	North Central	South	West	North-east	North Central	South	West	North-east	North Central	South	West
All ages..	48.5	59.7	56.9	64.4	47.6	56.1	53.8	59.9	8,877	14,200	7,600	7,182
Under 2.....	9.8	2.9	2.6	10.2	9.5	2.9	2.6	10.2	388	699	418	303
2-3.....	22.0	7.3	5.6	21.3	22.0	6.9	5.4	20.4	482	852	445	347
4-5.....	27.3	19.7	20.0	36.0	27.3	19.0	19.6	34.9	547	908	482	367
6-7.....	41.4	51.6	60.5	57.7	41.2	50.3	59.7	56.4	513	929	505	381
8-9.....	45.3	58.1	76.8	60.6	44.9	56.1	75.9	57.5	499	869	452	391
10-14.....	47.7	71.3	75.1	67.8	47.2	67.9	72.4	63.8	1,051	1,731	1,001	782
15-19.....	52.1	76.9	72.9	69.8	51.0	71.7	69.4	64.5	715	1,036	663	627
20-24.....	55.3	78.9	68.6	74.5	54.5	73.9	63.7	69.6	474	758	448	430
25-34.....	58.0	72.3	66.9	77.1	56.3	67.9	62.5	71.0	1,214	2,303	1,077	1,032
35-44.....	60.9	71.8	63.6	75.1	59.9	66.5	58.7	67.8	1,359	2,267	1,126	1,175
45-54.....	55.2	73.2	62.2	72.0	54.3	66.7	57.2	65.9	893	1,118	566	776
55 and over..	55.9	66.9	50.7	71.3	53.3	62.4	46.1	67.6	742	730	417	571

[1] A preceding paper (1) gives the number of families canvassed in each State classified according to the size of the city of residence. States included in the survey were—*Northeast:* New York, Massachusetts, Connecticut. *North Central:* Illinois, Ohio, Michigan, Indiana, Wisconsin, Minnesota, Kansas. *South:* District of Columbia, Virginia, West Virginia, Tennessee, Georgia. *West:* Washington, California, Colorado.

[2] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

Comparing this chart with figure 3, which shows similar data for cities of different sizes, less variation appears in the vaccinal status of different geographic sections than in that of cities of different sizes. The Northeast appears to be less well vaccinated than the other sections. However, in some geographic sections many cities are included in the surveyed sample, and in others the sample is more largely rural in composition. One cannot judge accurately the vaccinal status of an area without considering both size of city and section of the country.

The lower part of figure 4 shows for the different geographic sections the percentage of persons with a history of an attack of smallpox (table 7). In spite of an apparently low vaccinal status in the Northeast, it has the lowest smallpox history of any section; the cities of this region, however, are well vaccinated and probably have afforded protection to the rural areas. The West shows the highest proportion of persons with a history of smallpox, 4.5 percent for individuals of all ages; but the North Central and the South are not far behind, with 3.6 and 3.1 percent, respectively, as against 0.9 percent for the Northeast.

In the comparison of vaccination histories in this study with those of the White House Conference report for preschool children (17, p. 64), attention must be centered upon the early ages as they are different from the later ones. In the preschool years the Northeast and the West have higher vaccination history rates than the South,

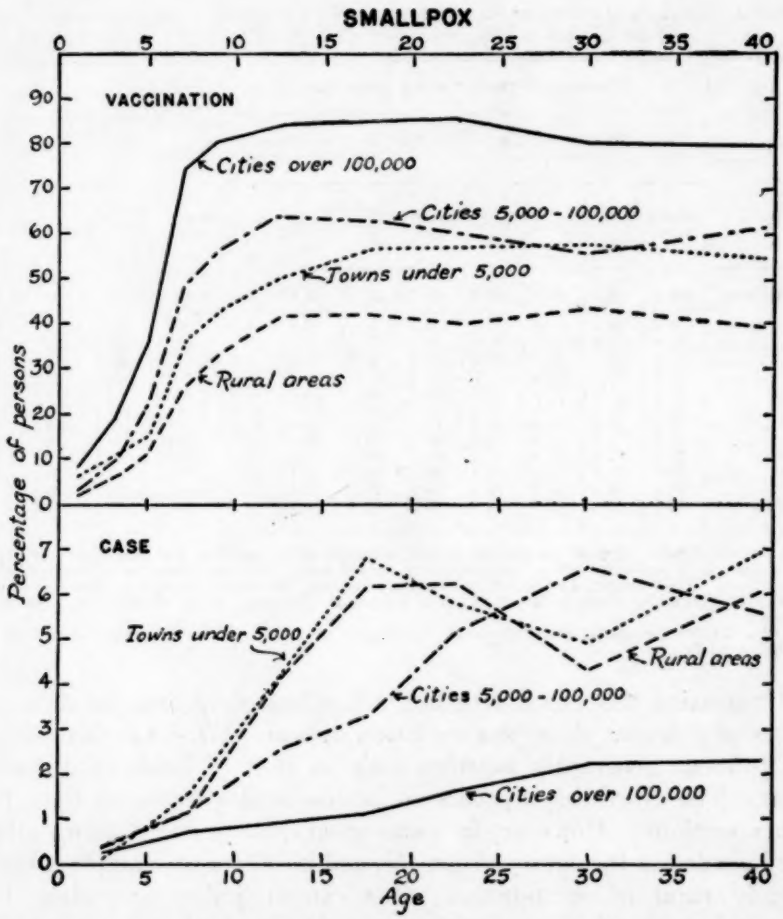

FIGURE 3.—Percentage of persons of specific ages in cities and rural areas (a) who had been vaccinated and (b) who had suffered an attack of smallpox—8,758 canvassed white families in 18 States, 1928-31

TABLE 7.—*History of smallpox cases among persons in 4 geographic sections*[1] *of the United States—canvassed white families in 18 States*[2]

Age in years	Percentage of persons with history of a case at any time				Number of persons with history of a case at any time				Total number of persons considered			
	North-east	North Central	South	West	North-east	North Central	South	West	North-east	North Central	South	West
All ages..	.91	3.63	3.05	4.54	81	516	232	326	8,877	14,200	7,600	7,182
Under 5.....	.09	.25	.27	.49	1	5	3	4	1,148	1,984	1,113	822
5-9.....	.23	1.45	.67	2.07	3	33	8	20	1,281	2,273	1,189	967
10-14.....	.48	3.35	2.70	3.96	5	58	27	31	1,051	1,731	1,001	782
15-19.....	1.12	5.21	3.47	5.26	8	54	23	33	715	1,036	663	627
20-24.....	.84	5.01	4.91	4.88	4	38	22	21	474	758	448	430
25-34.....	1.65	4.43	4.36	6.10	20	102	47	63	1,214	2,303	1,077	1,032
35-44.....	.96	5.29	4.88	7.32	13	120	55	86	1,359	2,267	1,126	1,175
45-54.....	.90	6.53	4.95	6.06	8	73	28	47	893	1,118	566	776
55 and over..	2.56	4.52	4.56	3.68	19	33	19	21	742	730	417	571

[1] For definition of sections, see note 1 to table 6.
[2] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

in agreement with the White House Conference report; but in that study the North Central ranks as high as the West, and the Northeast stands above all other sections in vaccinations. When the data in the present study are limited to cities (table 8), as in the data referred to in the White House Conference report, the Northeast stands far above the other areas, the West second, and the North Central and South at the bottom, with about the same rates.

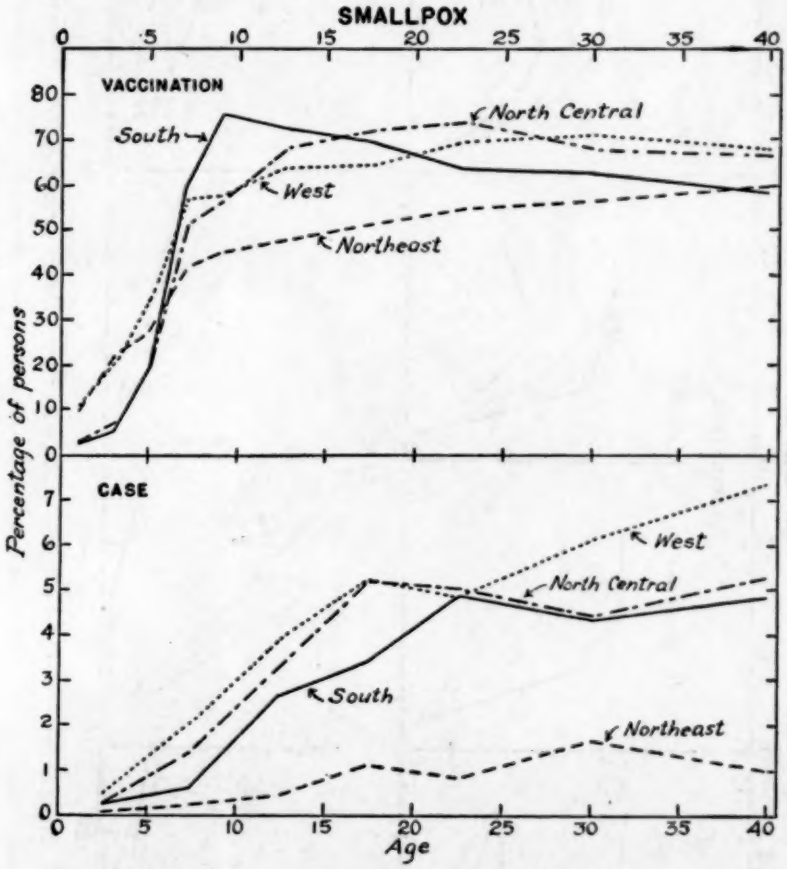

FIGURE 4.—Percentage of persons of specific ages in four geographic sections (a) who had been vaccinated and (b) who had suffered an attack of smallpox—8,758 canvassed white families in 18 States, 1928–31

Cities and rural areas in each geographic section.—Figure 5 shows the proportion of individuals who had been vaccinated in cities of different sizes in each of the four geographic regions (table 8). In each section, persons living in cities with populations of 100,000 or more are relatively well vaccinated; the proportion of adults in these places who had been vaccinated varies roughly from 80 to 90 percent. In the Northeast section, which appeared particularly low in figure 4, where all sizes of cities were considered together, 88 percent of chil-

dren 5 to 9 years of age living in large cities had been vaccinated. In the smaller cities and the rural parts of the Northeast, the proportion

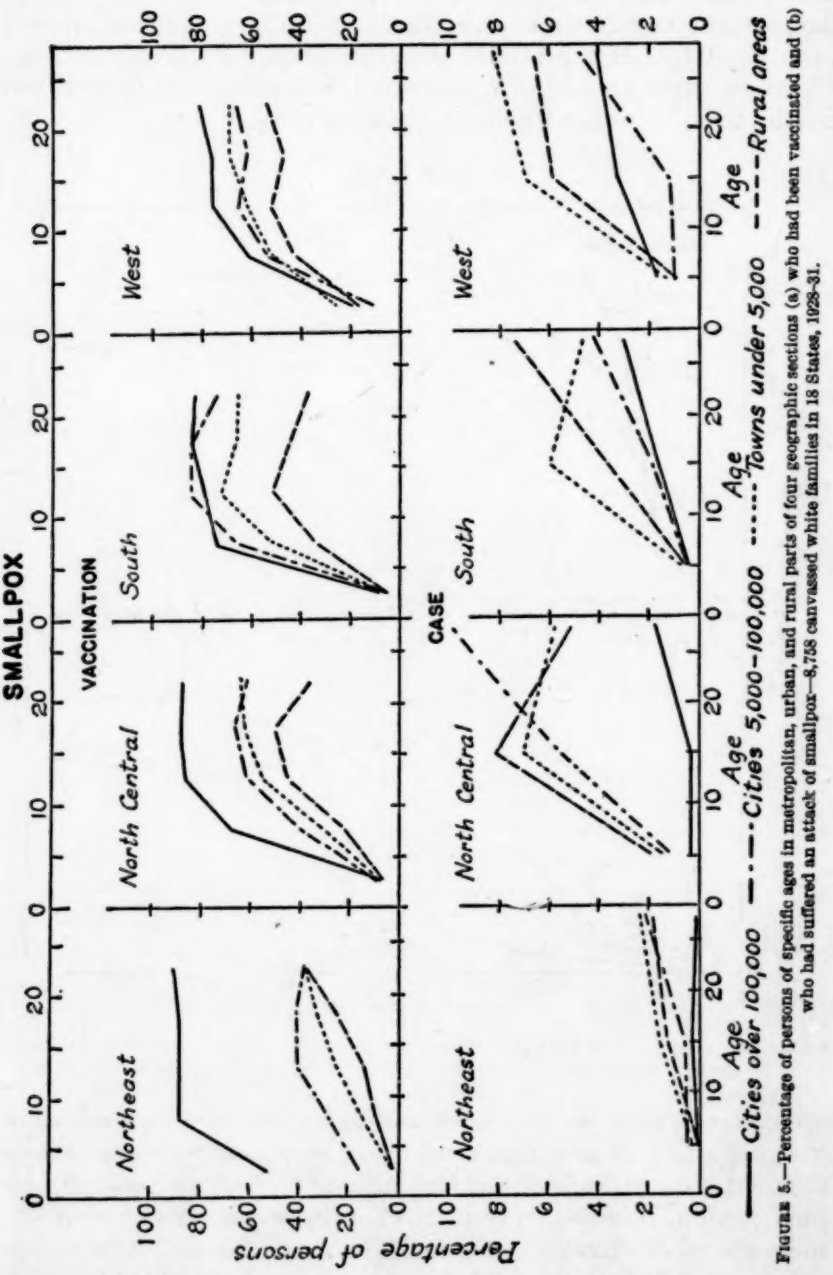

FIGURE 5.—Percentage of persons of specific ages in metropolitan, urban, and rural parts of four geographic sections (a) who had been vaccinated and (b) who had suffered an attack of smallpox—8,758 canvassed white families in 18 States, 1928-31.

of persons vaccinated was much lower; only 9 percent of the rural children 5 to 9 years and 13 percent of those 10 to 14 years of age had

been vaccinated. In the other three sections also the rural areas stand at the bottom, and in general the towns and the smaller cities fall between the large cities and the rural areas in the proportion of persons with a history of vaccination.

TABLE 8.—*History of smallpox vaccinations among persons in metropolitan, urban, and rural parts of 4 geographic sections [1] of the United States—canvassed white families in 18 States [2]*

Age in years	Percentage of persons with a history of—								Total number of persons considered [2]			
	Vaccination or case at any time				Vaccination at any time but no case							
	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas
	Northeast [1]											
All ages	82.2	87.2	32.4	27.0	81.9	36.1	31.1	25.8	2,872	1,831	2,411	1,763
Under 5	51.6	16.1	1.9	1.8	51.6	15.7	1.9	1.8	312	255	363	218
5–9	87.7	27.4	14.9	9.2	87.7	27.0	14.3	9.2	424	260	343	254
10–14	88.3	40.4	24.6	13.6	88.0	40.0	23.8	13.1	359	229	264	199
15–19	87.8	41.8	34.7	24.8	87.8	41.2	32.0	22.8	238	177	150	150
20–24	89.7	38.7	38.8	38.1	89.7	37.8	36.9	37.1	155	111	103	105
25–34	87.0	33.0	49.9	46.6	87.0	30.3	47.5	44.4	386	225	379	224
35–44	82.6	45.9	46.7	45.0	82.2	44.1	45.8	43.2	551	233	350	225
45 and over	83.4	52.4	46.9	35.9	82.1	50.9	44.9	34.1	447	341	459	388
	North Central [1]											
All ages	71.0	53.8	52.7	40.2	69.8	48.2	47.0	34.2	6,540	3,795	1,863	2,002
Under 5	7.4	8.7	7.5	6.4	7.4	8.4	7.1	5.6	893	602	239	250
5–9	66.7	41.2	31.6	24.7	66.1	39.4	29.7	22.1	947	657	361	308
10–14	86.6	65.5	61.8	51.8	86.3	61.1	55.4	45.4	724	429	267	311
15–19	88.8	73.2	69.7	60.8	88.3	65.7	61.5	50.3	436	254	146	200
20–24	88.8	71.8	69.2	45.7	87.0	60.8	63.0	35.8	448	164	65	81
25–34	82.2	64.3	67.2	45.2	80.5	54.6	61.5	41.9	1,210	621	262	210
35–44	82.7	69.7	68.1	46.7	80.5	62.2	60.9	38.2	971	656	321	319
45 and over	80.6	67.7	71.3	46.6	78.5	59.7	57.9	38.2	911	412	202	323
	South [1]											
All ages	67.6	61.4	56.5	36.7	65.8	58.8	52.2	32.3	1,910	2,908	1,152	1,630
Under 5	8.5	6.4	4.8	4.7	8.5	6.0	4.8	4.2	270	485	146	212
5–9	73.9	66.0	52.0	34.8	73.2	65.4	50.8	34.4	366	482	174	227
10–14	81.3	85.6	77.8	53.4	78.9	83.8	72.3	51.0	252	333	163	253
15–19	83.4	85.5	72.5	50.3	82.7	83.6	65.8	44.9	151	207	120	185
20–24	82.1	77.2	71.1	45.4	82.1	73.0	64.7	37.0	84	167	78	119
25–34	76.3	71.4	61.7	40.1	72.3	67.2	58.1	33.7	302	477	141	187
35–44	76.2	71.4	60.4	31.1	73.0	66.1	53.1	26.4	315	434	165	212
45 and over	74.6	60.6	59.9	37.0	72.9	57.2	54.4	28.3	230	323	165	265
	West [1]											
All ages	72.1	63.4	62.5	52.4	68.8	60.9	56.0	46.7	2,767	997	2,016	1,402
Under 5	19.8	10.3	24.6	15.6	18.6	10.3	24.6	15.6	324	78	285	135
5–9	62.9	55.2	54.7	43.3	60.7	53.5	52.2	41.9	316	116	318	217
10–14	78.9	66.7	65.7	57.7	76.4	64.9	61.0	51.6	242	114	213	213
15–19	80.4	62.2	78.1	52.1	76.1	61.4	68.2	46.6	210	119	152	146
20–24	83.4	64.5	76.3	59.7	80.0	64.5	67.5	53.3	176	62	114	78
25–34	84.2	74.3	74.9	61.6	79.9	66.7	66.9	55.0	464	105	312	151
35–44	84.5	73.7	73.7	58.1	80.4	69.4	59.9	50.0	468	186	296	223
45 and over	77.9	71.3	67.1	63.7	74.4	69.5	60.6	54.1	567	217	324	239

[1] For definition of sections, see note 1 to table 6.
[2] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

TABLE 9.—*History of smallpox cases among persons in metropolitan, urban, and rural parts of 4 geographic sections [1] of the United States—canvassed white families in 18 States [2]*

Age in years	Percentage of persons with history of a case at any time				Number of persons with history of a case at any time				Total number of persons considered			
	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas	Cities of 100,000 or over	Cities 5,000–100,000	Towns under 5,000	Rural areas
	Northeast [1]											
All ages	0.3	1.1	1.3	1.2	9	20	31	21	2,872	1,831	2,411	1,763
Under 10	------	.4	.3	------	------	2	2	------	736	515	706	472
10–19	.2	.5	1.4	1.1	1	2	6	4	597	406	414	349
20–34	------	2.1	2.3	1.8	------	7	11	6	541	336	482	329
35–44	.4	1.7	.9	1.8	2	4	3	4	551	233	350	225
45 and over	1.3	1.5	2.0	1.8	6	5	9	7	447	341	459	388
	North Central [1]											
All ages	1.2	5.6	5.7	6.0	78	212	106	120	6,540	3,795	1,863	2,002
Under 10	.3	1.1	1.3	1.8	6	14	8	10	1,840	1,250	600	558
10–19	.3	5.6	7.0	8.0	4	38	29	41	1,160	683	413	511
20–34	1.7	9.9	5.8	5.1	28	78	19	15	1,658	785	327	291
35–44	2.2	7.5	7.2	8.5	21	49	23	27	971	656	321	319
45 and over	2.1	8.0	13.4	8.4	19	33	27	27	911	412	202	323
	South [1]											
All ages	1.8	2.6	4.3	4.4	35	76	50	71	1,910	2,908	1,152	1,630
Under 10	.3	.5	.6	.5	2	5	2	2	576	967	320	439
10–19	1.7	1.8	6.0	3.6	7	10	17	16	403	540	283	438
20–34	3.1	4.2	4.6	7.2	12	27	10	20	386	644	219	276
35–44	3.2	5.3	7.3	4.7	10	23	12	10	315	434	165	212
45 and over	1.7	3.4	5.4	8.7	4	11	9	23	230	323	165	265
	West [1]											
All ages	3.3	2.5	6.4	5.7	91	25	130	80	2,767	997	2,016	1,402
Under 10	1.7	1.0	1.3	.8	11	2	8	3	640	194	603	352
10–19	3.3	1.3	6.8	5.8	15	3	25	21	452	233	365	359
20–34	4.1	4.8	8.2	6.5	26	8	35	15	640	167	426	229
35–44	4.1	4.3	13.8	8.1	19	8	41	18	468	186	298	223
45 and over	3.5	1.8	6.5	9.6	20	4	21	23	567	217	324	239

[1] For definition of sections, see footnote 1 to table 6.
[2] Dates of interviews varied from 1928 to 1931. Data refer to histories at the beginning of the 12-month morbidity study.

The lower part of figure 5 shows the history of smallpox cases in cities of different sizes in each geographic section (table 9). Considering first the Northeast, what appeared as an inconsistency now appears to show what might be expected, viz, the relatively well-vaccinated cities of 100,000 or over in this area have the lowest smallpox case history of any unit shown in the graph, amounting to only 0.3 percent for persons of all ages. The small cities, towns, and rural areas, which have fewer vaccinations, all have higher smallpox

history rates than the large cities in this section, but less than similar communities in other geographic regions. In every section the towns under 5,000 and the rural areas have higher smallpox history rates than the two classes of better vaccinated cities; the West is an exception in that towns under 5,000 in the surveyed group are as well vaccinated as cities 5,000 to 100,000, but the towns show considerably higher smallpox history rates than the cities. In spite of a generally better vaccinal status in towns under 5,000 than in rural areas, they show, in three of the four geographic regions, slightly higher smallpox case history rates than the rural areas, a result perhaps due to less contact between families on the farms.

It is probable that relatively well-vaccinated cities afford considerable protection to less vaccinated rural areas because smallpox epidemics frequently start in cities and spread to the country districts (16).

III. VACCINATIONS AND CASES DURING THE 12-MONTH STUDY

The record of all medical care, whether for illness or preventive service, affords accurate data on the frequency of vaccinations during the 12 months of the morbidity study.

The histories of prior vaccinations refer to the whole life of the individual and the resulting percentages tend to average out the periods of high and low vaccination rates. The record for the 1 year, although more accurate than the history data, may represent more frequent or less frequent vaccinations than the average over a period of years. As a test of the representativeness of the study year, the current rates may be cumulated [5] to approximate a curve of vaccination histories that would result from the repetition year after year of the current vaccination rates. Conversely, an approximation of the annual vaccination rates per 100 for given years of age may be obtained from the cumulative curve by computing differences between the percentages vaccinated for successive ages. Considering both phases of this test, the cumulative history curve indicates that about 23.6 [6] percent of children have been vaccinated by the time they reach their fifth birthday and the cumulation of the current rates up to 5 years of age gives 20.7 percent. To put it in another way, the cumulative figure of 23.6 percent by 5 years of age indicates an average annual rate under 5 years of 47.2 per 1,000, as against the observed rate of 42.1. Proceeding to 10 years, the history curve indicates that 60.2 percent were vaccinated by the tenth

[5] The method is valid only if all of the current vaccinations are first vaccinations, an assumption that seems approximately true up to 10 years of age.

[6] The figure 23.6 percent representing those who have been vaccinated by 5.0 years of age is a straight line interpolation between 20.1 at 4 years and 27.1 at 5 years of age at last birthday, which represent children of an average age of 4.5 and 5.5 years, respectively. Similar interpolations were made to determine figures for 10.0 and 15.0 years of age.

birthday, and the cumulated current rates give 55.8 percent. If one deducts from the 60.2 percent who have been vaccinated by the tenth birthday the 23.6 percent vaccinated before the fifth birthday, there are 36.6 percent vaccinated between the fifth and tenth birthdays, or an average annual rate of 73.2 per 1,000, as compared with an observed current rate at these ages of 70.3. Carrying the same computations to the fifteenth birthday, the history curve indicates that 65.3 percent had been vaccinated, and the cumulation of the current rates is 77.6 percent. The rate of vaccinations for 10 to 14 years as estimated from the histories amounts to only 10.2 per 1,000, as compared with an observed current rate of 43.6 per 1,000.

Up to the tenth year of age the current vaccination rates seem reasonably representative of average vaccination rates in preceding years in the same localities. Above 10 years, the disagreement may be due to one or more of the following reasons: (*a*) More vaccinations than usual in the current year, (*b*) incomplete reporting of vaccination histories, (*c*) more current immunizations being second vaccinations and therefore not adding to the percentage of persons with a history of prior vaccination.[7]

AGE, SEX, AND MARITAL STATUS

Figure 6 shows vaccinations during the study year per 1,000 persons in specific age and sex groups (table 10). The data for both sexes are shown in single years to 8 and in 2-year groups to 20 years. The current vaccination rate rises rapidly as age increases to a peak of 99 per 1,000 at 5 years; this maximum at the time of or just before school entrance no doubt reflects school regulations on vaccination. The frequency of vaccinations drops as age increases until at 18 to 19 and 20 to 24 years, the first ages after usual school life, the rates per 1,000 are 19 and 15, respectively. Aside from apparently chance fluctuations the rates continue a gradual downward trend to the end of the life span, with only 5 vaccinations per 1,000 among persons 65 years old or over.

During the school ages and up to about 25 years the vaccination rate is slightly higher for females than for males, but above those ages the reverse is true.

[7] Another test of the representativeness of the current vaccination rates might be made. If the histories for a given age represent the proportion vaccinated at the beginning of the 12-month study, one can add to this percentage the proportion of the same age who were vaccinated during the year of the study and obtain the percentage with a history of vaccination at the end of the study year. However, the individuals are all a year older at the end of the year than at its beginning, and so each age must be increased by one year to make the data comparable with results for the beginning of the year. When this procedure is carried out the new curve of histories of vaccination at the end of the year is, up to 10 years, quite similar to the curve for the beginning of the year.

Considering persons 20 to 34 years of age the vaccination rate for married men is three times that for single; among women the rate for the married is only slightly above that for the single (table 11).

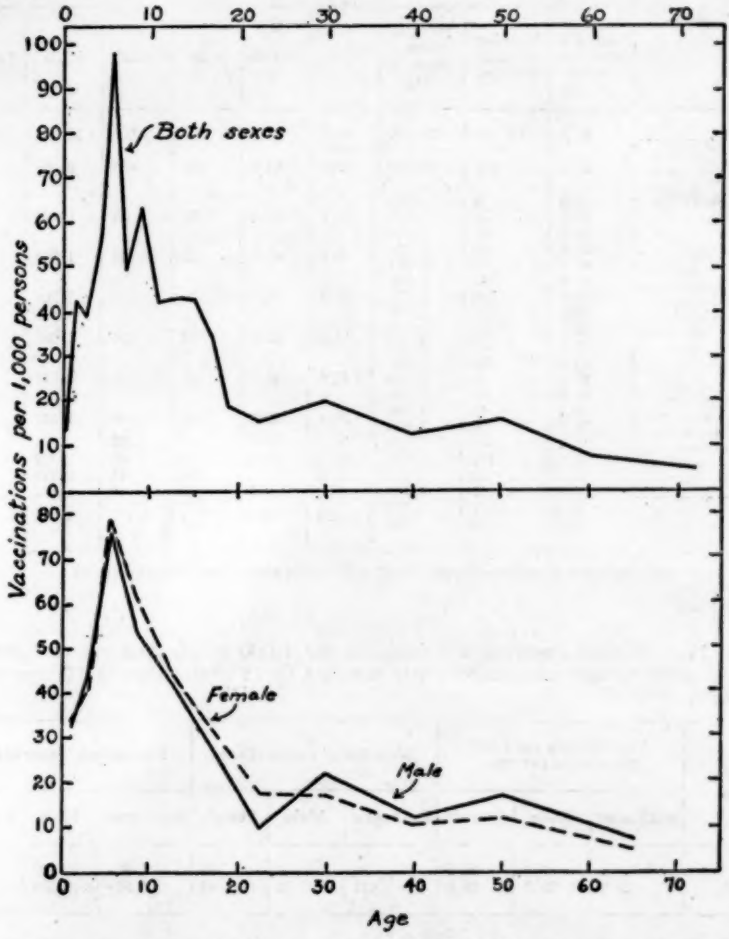

FIGURE 6.—Annual smallpox vaccinations per 1,000 persons of specific ages for each sex—8,758 canvassed white families in 18 States during 12 consecutive months, 1928–31.

FAMILY INCOME

Figure 7 shows vaccination rates among persons classified according to total family income (table 12). Considering all ages, families with less than $1,200 a year and those with $5,000 and over a year had about the same vaccination rates, but both are nearly twice the rates for the three intervening income classes. Considered for persons of specific ages, the lowest and highest income groups have the highest rates at each age. Among children under 5 years, aside from the high

TABLE 10.—*Annual smallpox vaccinations per 1,000 persons of specific ages of each sex—canvassed white families in 18 States during 12 consecutive months, 1928–31*

Age in years	Both sexes [1]			Vaccinations per 1,000 population per year		Number of vaccinations		Population (years of life)	
	Vaccinations per 1,000 population per year	Number of vaccinations	Population (years of life)	Male	Female	Male	Female	Male	Female
All ages [1]	31.4	[1] 1,209	[1] 38,544	31.3	31.5	[1] 591	[1] 618	[1] 18,896	[1] 19,627
Under 20	49.0	923	18,846	47.3	50.8	447	476	9,456	9,369
Under 6 months	13.3	6	450						
6–11 months	27.8	15	540	32.7	34.6	37	38	1,133	1,097
1	42.8	54	1,261						
2	39.3	41	1,044	43.9	42.0	48	43	1,093	1,023
3	46.6	50	1,072						
4	57.6	66	1,146						
5	99.0	116	1,172	76.1	78.7	130	139	1,709	1,767
6	75.1	87	1,158						
7	49.5	58	1,171	54.9	62.6	93	106	1,693	1,692
8–9	63.7	141	2,214						
10–11	42.4	84	1,980						
12–13	43.0	75	1,744	[2] 42.6	44.6	98	101	2,301	2,267
14–15	42.5	65	1,530						
16–17	34.7	45	1,296	[3] 26.8	32.2	41	49	1,527	1,523
18–19	18.7	20	1,068						
20–24	15.1	32	2,119	10.1	18.8	9	23	894	1,225
25–34	19.9	112	5,640	22.5	17.9	54	58	2,402	3,238
35–44	12.1	72	5,930	12.8	11.5	38	34	2,979	2,951
45–54	15.5	52	3,351	17.9	12.6	33	19	1,845	1,506
55–64	7.5	11	1,473	7.3	5.7	9	7	1,241	1,230
65 and over	5.0	5	998						

[1] "All ages" includes a few of unknown age; "both sexes" includes a few of unknown sex.
[2] 10–14 years.
[3] 15–19 years.

TABLE 11.—*Annual smallpox vaccinations per 1,000 single and married persons 20–34 years of age—canvassed white families in 18 States during 12 consecutive months, 1928–31*

Marital status	Vaccinations per 1,000 population per year			Number of vaccinations			Population (years of life)		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
Single	12.1	7.6	16.9	22	7	15	1,812	922	890
Married	20.8	23.7	18.8	122	56	66	5,869	2,364	3,505

rate in the lowest income class, the rates increase rapidly with income.[8] At the early school ages, 5 to 9 years, the poor and well-to-do have higher vaccination rates, but the three intervening groups all show rates of about the same magnitude. In the later school ages, 10 to 14 and 15 to 19, vaccinations tend to decrease as income increases between the range of $1,200 and $5,000, probably due in part to the fact that more children in the higher income classes were vaccinated in the preschool ages; it has already been seen that few revaccinations occur.

[8] This result is in general agreement with the findings in the study of preschool children by Palmer, Derryberry and Van Ingen (17, p. 51) except that the lowest economic group in their study does not show more frequent vaccinations than the middle groups.

TABLE 12.—*Annual smallpox vaccinations per 1,000 persons of specific ages in different income levels—canvassed white families in 18 States during 12 consecutive months, 1928–31*

Annual family income	All ages [1]	Under 5	5–9	10–14	15–19	20–44	45 and over
	Vaccinations per 1,000 population per year						
Under $1,200	48.8	46.8	96.2	69.0	40.9	36.4	13.4
$1,200 but under $2,000	26.3	24.4	60.6	40.9	26.4	13.1	6.3
$2,000 but under $3,000	24.8	35.0	64.6	30.4	28.8	8.5	8.5
$3,000 but under $5,000	24.2	60.2	56.1	25.1	15.9	12.7	8.2
$5,000 and over	44.6	133.2	97.6	59.5	39.2	20.4	24.3
	Number of vaccinations						
Under $1,200	284	45	90	54	19	64	12
$1,200 but under $2,000	353	54	132	66	26	63	10
$2,000 but under $3,000	235	48	91	34	21	30	11
$3,000 but under $5,000	119	32	36	13	7	24	7
$5,000 and over	209	51	49	30	17	34	28
	Population under observation [2]						
Under $1,200	5,820	962	936	783	464	1,758	896
$1,200 but under $2,000	13,419	2,216	2,178	1,612	983	4,792	1,506
$2,000 but under $3,000	9,491	1,370	1,409	1,118	728	3,537	1,299
$3,000 but under $5,000	4,911	532	642	517	441	1,893	855
$5,000 and over	4,689	383	502	504	434	1,670	1,154

[1] "All ages" includes a few of unknown age.

[2] Nearly all persons were under observation during the entire 12 months. For births during the study an adjustment was made to reduce their observation period to full-time years of life.

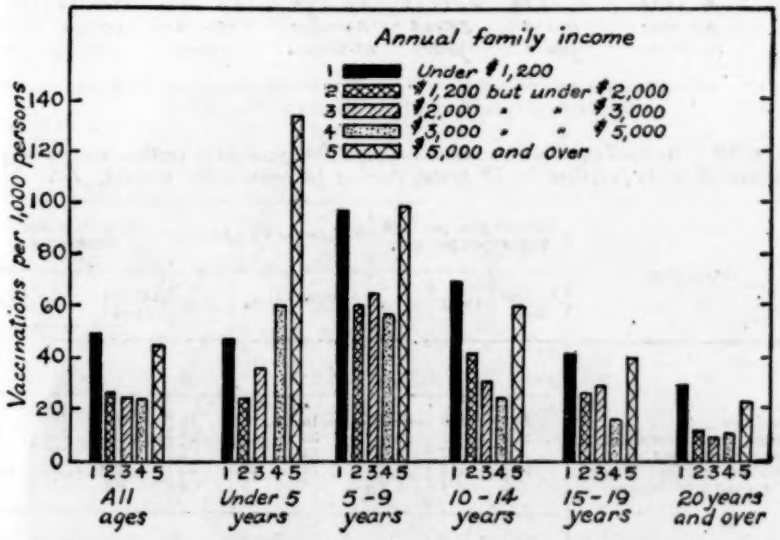

FIGURE 7.—Annual smallpox vaccinations per 1,000 persons of specific ages in 8,758 canvassed white families of different income levels in 18 States during 12 consecutive months, 1928–31.

Vaccinations were more frequent during the study year among clerical and professional men than among the artisan and laboring groups. Farmers had lower vaccination rates than any of these classes (fig. 8 and table 13).

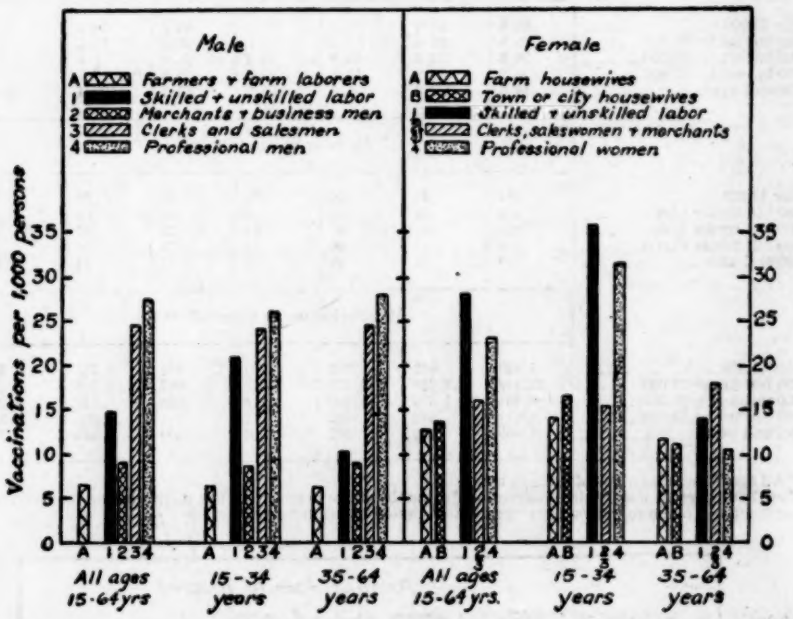

FIGURE 8.—Annual smallpox vaccinations per 1,000 persons in certain occupations—8,758 canvassed white families in 18 States during 12 consecutive months, 1928–31.

TABLE 13.—*Annual smallpox vaccinations per 1,000 persons in certain occupations—canvassed white families in 18 States during 12 consecutive months, 1928–31*

Occupation	Vaccinations per 1,000 population per year			Number of vaccinations			Population under observation		
	All ages 15–64	15–34	35–64	All ages 15–64	15–34	35–64	All ages 15–64	15–34	35–64
	Male								
Professional	27.2	25.9	27.7	18	5	13	662	193	469
Merchants and business	24.3	24.1	24.4	32	8	24	1,316	332	984
Clerks and salesmen	8.9	8.7	9.0	13	6	7	1,464	690	774
Skilled and unskilled laborers	14.8	20.8	10.2	59	36	23	3,984	1,732	2,252
Farmers and farm laborers	6.3	6.4	6.2	6	2	4	938	311	647
	Female								
Professional	23.0	31.5	10.4	11	9	2	478	286	192
Clerks, saleswomen, and merchants	15.9	15.3	18.0	12	9	3	755	588	167
Skilled and unskilled laborers	27.8	35.7	13.9	11	9	2	396	252	144
All housewives [1]	13.4	16.3	11.2	106	56	50	7,897	3,444	4,453
Town or city housewives	13.6	16.6	11.1	89	49	40	6,548	2,947	3,601
Farm housewives	12.6	14.1	11.7	17	7	10	1,349	497	852

[1] "Housewife" here means a person in charge of the home, and therefore includes a few single women.

VACCINATIONS IN DIFFERENT LOCALITIES

It has been seen that, as measured by vaccination histories, cities are considerably better vaccinated than the small towns and rural areas. This does not necessarily imply that vaccinations during any 1 year would be more frequent in large cities; in fact, if vaccination is consistently enforced, the number vaccinated each year might be fairly small.[9]

Vaccinations during the 12-month period of this study were largely concentrated in a few communities. In table 14 the localities have been classified into those with large numbers of vaccinations in the surveyed families, those with few or scattered vaccinations only, and those with no vaccinations during the year. The table omits the few communities that were represented by less than 10 families; the great majority of the places included 30 or more households, the average being 73 families per community.

TABLE 14.—*Percentage of localities, of families, and of smallpox vaccinations in places with large numbers of vaccinations, with few vaccinations, and with no vaccinations in the surveyed group—canvassed white families in 119 localities with 10 or more families under observation during 12 consecutive months, 1928–31*

Vaccinations in the surveyed families during the year of the study	Percentage of—			Number of—		
	Localities	Families	Vaccinations	Localities	Families	Vaccinations
All localities	100.0	100.0	100.0	119	8,713	1,205
Localities with large numbers of vaccinations (20 or more per 100 families) in the face of a smallpox epidemic or threatened epidemic	10.1	9.3	74.2	12	807	894
Localities with few vaccinations	46.2	61.1	25.8	55	5,328	311
Localities with no vaccinations	43.7	29.6	----------	52	2,578	----------

Twelve communities, or 10 percent of the 119 localities, including 9 percent of the surveyed families, contributed 74 percent of the vaccinations during the year. The other 26 percent of the vaccinations were done in 55 communities (46 percent) which included 61 percent of the families. Forty-four percent of the communities, including 30 percent of the families, contributed no vaccinations during the study year. The smaller number of surveyed families per community in this last group would make for more localities without vaccinations but would not account for anything like all of them being without vaccinations.

Relation of smallpox epidemics to the frequency of vaccination.—The 12 localities that contributed nearly three-quarters of the vaccinations have all been classed as having epidemics or facing threatened epi-

[9] About 2 percent of the total population of all ages, as enumerated in the census of 1930, were 6 years old; if every child were vaccinated at school entrance these vaccinations would amount annually to only 20 per 1,000 total population. Revaccination every 7 years would mean that 1/7 of the population is vaccinated every year, or an average annual rate of 143 vaccinations per 1,000 population.

demics; the threatened epidemic, however, was not always within their own county. In table 15, the three vaccination classes of communities shown in table 14 have been further classified according to whether the smallpox cases reported [10] constituted an epidemic anywhere within the county. Since reported cases of smallpox were not available for the small communities, it was necessary to consider the county as the unit. "Epidemic", as used here, means that more than the usual number of cases of smallpox were reported; rather small numbers of cases were sometimes considered epidemic if they were concentrated within 1 or 2 months.

TABLE 15.—*Comparison of the epidemic presence of smallpox as reported to health departments for the whole populations of surveyed localities where there were large numbers of vaccinations in the surveyed families during the study year with that in communities where there were few vaccinations and where there were no vaccinations—119 surveyed localities with 10 or more families under observation during 12 consecutive months, 1928–31*

Vaccinations in the surveyed families during the year of the study	Localities			Families			Vaccinations		
	Total	Smallpox was—		Total	Smallpox was—		Total	Smallpox was—	
		Epidemic in the city or county	Not epidemic in the city or county		Epidemic in the city or county	Not epidemic in the city or county		Epidemic in the city or county	Not epidemic in the city or county
	Percentage								
Localities with large numbers of vaccinations (20 or more per 100 families)	100.0	75.0	25.0	100.0	86.7	13.3	100.0	85.4	14.6
Localities with few vaccinations	100.0	23.6	76.4	100.0	25.2	74.8	100.0	22.5	77.5
Localities with no vaccinations	100.0	28.9	71.1	100.0	30.6	69.4	-------	-------	-------
	Number								
Localities with large numbers of vaccinations (20 or more per 100 families)	12	9	3	807	700	107	894	763	131
Localities with few vaccinations	55	13	42	5,328	1,344	3,984	311	70	241
Localities with no vaccinations	52	15	37	2,578	789	1,789	-------	-------	-------

In 9 places, or 75 percent, of the 12 communities with large numbers of vaccinations, including 87 percent of the families in the 12 communities, smallpox was epidemic within the town or county. On the other hand, smallpox was epidemic in only 24 percent of the 55 localities with few vaccinations and in 29 percent of the 52 localities with no vaccinations. Thus it appears that localities with few or no vaccinations are chiefly those without epidemics and localities with large numbers of vaccinations are chiefly those with epidemics. Reference

[10] Resort to health department records was necessary because the expectancy of smallpox is too small to be obtained from the survey records of the limited numbers of families canvassed in a given community.

to the table indicates that the distribution of families and vaccinations as between epidemic and nonepidemic counties shows the same association between large numbers of vaccinations and the presence of a smallpox epidemic.

In the nine communities with large numbers of vaccinations with smallpox epidemic in the town or county, the vaccinations were highly concentrated in the months in which the largest numbers of smallpox cases were reported, thus indicating that the presence of smallpox supplied the motive for vaccinating or the occasion for health officials to urge vaccination. The following facts about the nine communities may be of interest:

In a New York town of about 12,000 population there were 344 vaccinations in the 99 families under observation. Twenty-one cases of smallpox were reported to the health department during the first 5 months of 1930 (16 in April), and 334 of the vaccinations occurred in the same 5 months (125 in April). Sixty-eight percent of the 502 persons under observation in this town were vaccinated during the study year. Two cases of smallpox were reported in the surveyed families, but there were no deaths from smallpox in the whole of New York State in 1929 or 1930.

In an Indiana city of about 32,000 population, there were 139 vaccinations in the 83 families included in the survey. In the 6 months from December 1929 to May 1930 there were 235 cases of smallpox in the county (reports not available for the city alone), and 130 of the 139 vaccinations in the canvassed families occurred during this 6-month period.

The other seven communities with large numbers of vaccinations in the face of an epidemic need not be described in detail. They include an Ohio city of about 105,000 population with 70 vaccinations in the 91 families under observation; an Indiana city of about 115,000 with 47 vaccinations in the 126 families under observation; one Kansas town of about 14,000 with 20 vaccinations in the 91 families under observation and another of about 10,000 population with 33 vaccinations in the 73 families under observation; a Colorado town of about 11,000 with 29 vaccinations in the 31 families under observation; an Ohio town of about 2,700 population with 42 vaccinations in the 86 families under observation; and a Wisconsin town of about 2,300 with 33 vaccinations in the 39 families under observation.

Vaccinations in the above-named places all amounted to 20 or more per 100 families under observation (40 to 50 per 1,000 persons). Places with less than this number were classed as having few vaccinations, and in the great majority of localities there were very few or no vaccinations in spite of the fact that in about one-fourth of the communities smallpox was epidemic in the city or county. The presence of smallpox in the community may go unnoticed unless the health department makes use of the occasion to urge vaccinations, as is commonly done according to a Michigan report (11, 1929, p. 48).

The three communities with large numbers of vaccinations in which smallpox was not epidemic in the town or county are of special interest.

In a New York village of about 1,200 population, there were 81 vaccinations in the 49 families included in the survey. One case of smallpox (not fatal) was reported to the health department as occurring in the village in April 1930, and

73 of the 81 vaccinations in the surveyed families were done in that month. Since there was only the one smallpox case in the whole county, the disease could not be classed as epidemic, but its presence in the community was clearly associated with the large number of vaccinations.

In another New York village of about 500 population, there were 17 vaccinations in the 45 families included in the survey. No case of smallpox was reported in the whole county during the year of the study, but in an adjacent county 26 cases occurred in November and 3 in December of 1930 (no deaths). Of the 17 vaccinations in the surveyed families, 1 was done in November and 13 in December of 1930, suggesting that the neighboring epidemic was the reason for the vaccinations.

In a town of about 1,800 in Wisconsin, there were 33 vaccinations in the 16 families under observation. There were no cases reported to the health department as occurring anywhere in the county during the year of the survey. However, there were 4 cases in January of 1930 in an adjacent Wisconsin county and 4 cases in January, 2 in February, and 4 in March in an adjacent county of the upper peninsula of Michigan. Since 23 of the 33 vaccinations in the surveyed families were done in February and 7 in March of 1930, it appears probable that smallpox in these adjacent counties supplied the motive for the vaccinations.

No information is available on the activities of the health departments in these or other localities in the survey, but the connection between smallpox in an adjacent county and vaccinations in a given community may represent a vaccination campaign by the health department rather than any general fear of the spread of smallpox. During 1924, when the severe form of smallpox was epidemic in Detroit, there were 813,000 vaccinations in the then population of 1,194,000 (8, p. 42).

TABLE 16.—*Age distribution of smallpox vaccinations in communities having large numbers of vaccinations in the face of a smallpox epidemic or threatened epidemic compared with that in communities with scattered vaccinations only—canvassed white families in 18 States during 12 consecutive months, 1928–31*

Vaccinations in the surveyed families during the year of the study	All known ages	Under 5	5–9	10–14	15–19	20–34	35–54	55 and over
	Percentage of the vaccinations that were in each age group							
12 localities with large numbers of vaccinations (20 or more per 100 families) in the face of a smallpox epidemic or threatened epidemic	100.0	12.3	31.8	19.0	8.4	15.0	12.0	1.5
55 localities with few vaccinations	100.0	39.3	38.1	9.4	4.5	3.2	5.2	.3
	Number of vaccinations							
12 localities with large numbers of vaccinations in the face of a smallpox epidemic or threatened epidemic	893	110	284	170	75	134	107	13
55 localities with few vaccinations	310	122	118	29	14	10	16	1

Age distribution of vaccinations in the face of epidemics.—A consideration of the age distribution of the persons currently vaccinated in the different categories of localities is of interest (table 16). In the 12

communities with large numbers of vaccinations in the face of an epidemic or threatened epidemic, 12 percent of the vaccinations were of children under 5 years and 29 percent were of persons over 20 years old. In the 55 localities with scattered or few vaccinations only, the average age of vaccination was much younger, 39 percent of the persons vaccinated during the study being under 5 years and only 9 percent over 20 years of age.

Seasonal distribution of vaccinations in the face of epidemics.—The data already presented suggest that vaccinations, particularly in the face of epidemics, have a seasonal distribution like smallpox cases.

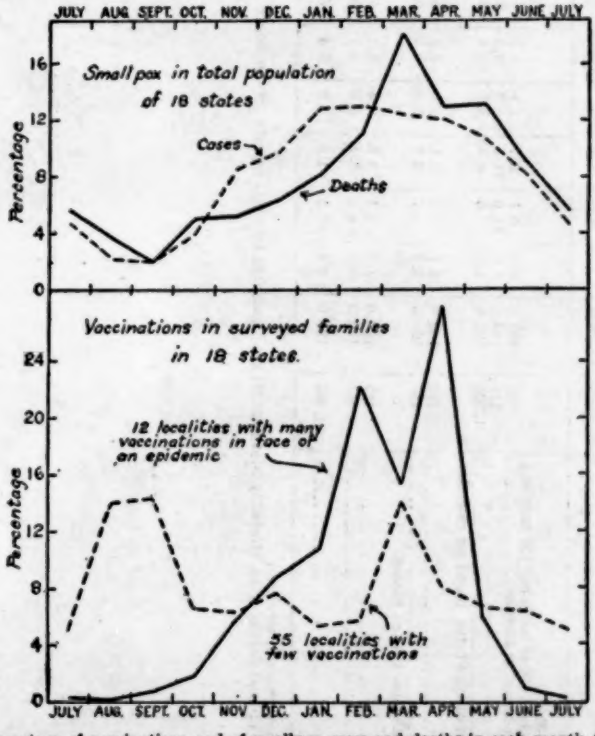

FIGURE 9.—Percentage of vaccinations and of smallpox cases and deaths in each month (30-day basis)—vaccinations in 8,758 surveyed families, 1928–31; cases and deaths in the general population, 1929–30.

Table 17 and figure 9 show for the surveyed population the percentage of vaccinations in each month, and for the general population the percentage of smallpox cases and deaths in each month, adjustment in all instances being made for the varying length of the months. Considering the few localities included in the group with many vaccinations in the face of an epidemic or threatened epidemic, the seasonal distribution of these vaccinations is fairly similar to that of smallpox cases but is more like that of smallpox deaths. In the communities with few vaccinations, relatively more of the vaccinations occur in August and September, apparently in preparation for

TABLE 17.—*Seasonal distribution of smallpox vaccinations in the surveyed families and of smallpox cases and deaths in the general population*

	All months		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
	Number	Percent	Percentage in each month (corrected to 30-day basis)											
Vaccination in the surveyed population,[1] 1928–31:														
12 localities with large numbers of vaccinations (20 or more per 100 families) in the face of a smallpox epidemic or threatened epidemic	894	100.0	0.3	0.1	0.7	1.8	5.7	8.7	10.7	22.2	15.3	27.8	5.8	0.9
55 localities with few vaccinations	311	100.0	5.0	14.0	14.3	6.7	6.3	7.7	5.3	5.7	14.0	8.0	6.7	6.3
All localities [1]	1,205	100.0	1.5	3.6	4.1	3.1	5.9	8.5	9.3	18.0	14.9	22.7	6.1	2.3
Smallpox [2] in the total population of the 18 surveyed States, based on calendar years 1929–30:														
Cases	52,496	100.0	4.7	2.2	2.0	3.9	8.5	9.7	12.8	13.0	12.4	12.0	10.7	8.1
Deaths	157	100.0	5.6	3.7	2.0	5.0	5.2	6.3	8.1	11.0	18.1	12.9	13.1	9.0
Smallpox [2] in the total population of the Continental United States:														
Based on calendar years 1929–30:														
Cases	91,189	100.0	4.5	2.1	1.8	3.4	7.1	8.8	12.7	13.2	13.6	13.1	11.1	8.6
Deaths	347	100.0	5.2	4.1	3.5	2.9	5.2	6.7	8.2	14.5	15.7	14.0	11.3	8.7
Based on medians for the 7 years 1922–28:														
Cases	31,067	100.0	4.5	2.5	1.8	2.9	5.4	7.8	14.6	15.8	13.7	12.7	10.7	7.6

[1] Excludes localities with less than 10 families under observation.
[2] Cases from Notifiable Diseases in States (12) and deaths from Mortality Statistics (7) supplemented by State reports (12) for South Dakota in 1929 and Texas in 1929 and 1930.

the opening of school; there is also a peak in March, when the peak in smallpox deaths occurs. It will be remembered that smallpox was epidemic in nearly one-fourth of these communities with few vaccinations (table 15), and the March peak probably reflects the influence of these epidemics although no large number of vaccinations occurred.

SMALLPOX VACCINATIONS IN ATTACKED HOUSEHOLDS

Vaccinations prior to the study.—The vaccinal status of the families attacked by smallpox is of interest. Of the 67 persons in the 14 households which were attacked during the 12-month study, 48 persons, or 72 percent, had never been vaccinated or had a case, as compared with 43 percent in the whole surveyed group. Twelve persons, or 18 percent, of the 67 in the attacked households had been vaccinated at some time, as compared with 54 percent in the whole surveyed group; in 10 of the 12 persons the vaccination was more than 7 years previous to the study and in another the time was not ascertained. Of the 67 individuals, 7 persons, or 10 percent, had suffered attacks of smallpox prior to the study, as compared with 3 percent in the whole surveyed group. However, 5 of the 7 persons were in one family; hence, only 3 of the 14 families had been previously attacked by smallpox.

Of the 31 children under 15 years of age in attacked households, none had been vaccinated, as compared with 41 percent in the whole surveyed group. The data suggest that the households that were attacked by smallpox during the study had less vaccinal protection and more histories of prior smallpox than the average for the whole surveyed group.

Vaccinations during the 12-month study.—Of the 32 persons in attacked households who had never been vaccinated and who were not attacked, 22 persons, or 69 percent, were vaccinated during the year.[11] Only 2 of the 9 individuals, 22 percent, who had been vaccinated more than 7 years previously and who were not attacked were vaccinated during the year.

[11] Of the 22 vaccinations, 16 were done just before or just after the onset of the case in the household and presumably as a protection against it or the case to which it was exposed; 4 vaccinations of nonattacked persons were done some weeks prior to the case and hence could not be the result of the presence of the case in the household; the other 2 vaccinations were done about a month after the case on children who were temporarily away from the household at the time of the case.

SMALLPOX CASES IN THE OBSERVED POPULATION

There were 17 cases [12] of smallpox in the whole surveyed population, which gives an annual case rate of 44.1 per 100,000 persons as compared with a reported average annual rate for the United States of 37.1 for the years 1929–30, a period approximating that covered by the survey. When one takes into account possible incompleteness [13] of the reports to the health departments, the rate in the surveyed group seems to be about what obtained in the United States at that time.

Data are available on the vaccinal status of all persons in the observed population. The cases of smallpox are too few and scattered [14] to afford a reliable comparison of the incidence of the disease in vaccinated and unvaccinated groups, but it will be of interest to make the comparison for what it is worth. Table 18 shows, by age, smallpox incidence among the total observed population, among those not vaccinated within 7 years (including those never vaccinated), and among those never vaccinated. In all categories, and particularly among the unvaccinated, smallpox rates are higher from 5 to 15 years than before or after those ages, in general agreement with the findings of Stocks for the Metropolitan Borough of Stepney in London (18, p. 220).

Sixteen of the 17 smallpox cases in the observed population occurred among persons with no history of vaccination or case, a rate of 96 per 100,000 population, as compared with a rate of 5 per 100,000 (1 case) among persons who had been vaccinaed or had had a case (table 19). The 1 case occurred in a person vaccinated 40 years

[12] The 17 cases of smallpox occurred in 14 households, 12 families having only 1 case, 1 family 2 cases (1 secondary), and 1 family 3 cases, but with onsets all on the same date, so all were primary cases. There was a total of 67 persons in the attacked households; the 17 cases give an attack rate of 25 per 100 persons in attacked families. Of the 17 cases, 16 occurred among 48 individuals who had never been vaccinated, an attack rate of 33 per 100. Among 10 persons who had been vaccinated more than 7 years previously, 1 case occurred (vaccinated 40 years previously), an attack rate of 10 per 100.

Ten of the 17 cases occurred among the 31 persons under 15 years of age, an attack rate of 32 per 100, as compared with 19 per 100 among the 36 persons over 15 years old. Among the 17 persons over 15 years of age who had never been vaccinated or suffered a prior attack, 6 cases occurred, an attack rate of 35 per 100, which is about the same as that among the children under 15 years, none of whom had been vaccinated. Stocks found attack rates among unvaccinated contacts as high in adult ages as in childhood (18, p. 220).

[13] A canvass of over 27,000 families, including nearly 120,000 individuals, in various counties of Illinois (10, p. 28) indicated that 67 percent of the 425 smallpox cases that occurred in the group during 1929 were reported to the health department. In general a slightly higher percentage of the cases was reported in the counties with large cities than in the more rural counties.

[14] The 14 attacked households (17 cases) were distributed as follows:

State	Number of families attacked	Number of cases of smallpox	Number of families under observation
Indiana	8	11	494
Washington	3	3	551
New York	2	2	1,710
Ohio	1	1	1,148

previously, a rate of 8 per 100,000 in the group with a history of vaccination 7 or more years previously.

TABLE 18.—*Age incidence of smallpox in the total observed population and in relatively nonimmune parts of that population—canvassed white families in 18 States during 12 consecutive months, 1928–31*

	All ages [1]	Age				
		Under 5	5–9	10–14	15–34	35 and over
Total observed population:						
Number of persons (years of life)	[1] 38,544	5,513	5,715	4,568	10,809	11,732
Number of cases	17	3	4	3	4	3
Annual case rate per 100,000	44	54	70	66	37	26
Persons with no history of vaccination within 7 years or of a prior case at any time:						
Number of persons	[1] 28,396	[2] 4,907	2,884	2,099	8,325	10,034
Number of cases	17	3	4	3	4	3
Annual case rate per 100,000	60	61	139	143	48	30
Persons with no history of vaccination or prior case at any time:						
Number of persons	[1] 16,603	[2] 4,907	2,849	1,547	3,302	3,910
Number of cases	16	3	4	3	4	2
Annual case rate per 100,000	96	61	140	194	121	51

[1] "All ages" includes a few of unknown age.

[2] "Under 5 years" includes 441 years of life for the 761 children born during the study who are excluded from the history of vaccination tables because the histories are recorded as of the beginning of the study before these children were born. Since they are exposed to the risk of attack, they belong in any table of current rates.

TABLE 19.—*Annual incidence of smallpox in unvaccinated and vaccinated groups of the surveyed population—canvassed white families in 18 States during 12 consecutive months, 1928–31*

	Number of persons under observation	Case rate per 100,000	Actual number of cases	Expected number of cases if there had been no history of vaccination or case (age corrected)[1]
No history of a vaccination or prior case	16,603	96.4	16	16
History of a vaccination or case at any time	21,719	4.6	1	23
History of vaccination 7 or more years prior to study	11,793	8.5	1	10
History of vaccination within 7 years of study	8,769	----	0	12
History of a case	1,157	----	0	1

[1] Expected cases obtained by applying age specific rates (table 18) for persons who had never been vaccinated to the numbers of persons in the various ages in the group under consideration.

The significance of the difference between the expected and actual number of cases for a given group was tested as follows: (*a*) An expected rate was computed by dividing the expected cases by the number of persons in the group; (*b*) the standard error of the *expected number* of cases was computed by the formula, $\sigma = \sqrt{npq}$, in which n=number of persons in group, p=expected rate per person, and q=1–p; (*c*) difference between actual and expected number of cases, z, was divided by the standard error, σ, as computed above; (*d*) from tables of $\frac{z}{\sigma}$ in Pearl's Medical Biometry and Statistics (2d ed., p. 440), the probability of a chance deviation as great as, or greater than, that occurring in this case was obtained.

The results indicate that the actual cases are significantly lower than expected for all except the last group (history of a prior case). The number of individuals in this group is too small to obtain reliability when dealing with as small a rate as that for smallpox.

The age specific rates in table 18 for persons who had never been vaccinated have been applied to the population of different ages in the several groups shown in table 19. Among the 21,719 persons who had been vaccinated or had suffered an attack, there was 1 case,

as compared with an expectancy of 23 cases if the rates had been what they were in the unvaccinated group; among the 11,793 who had been vaccinated 7 or more years previously, the expectancy was 10 cases, with only 1 case occurring; in the 8,769 persons vaccinated within 7 years, there was an expectancy of 12 cases, but none occurred, and in the 1,157 with a prior attack of smallpox there was an expectancy of 1 case, but none occurred. With the exception of the last group the differences between the actual and expected numbers of cases are much greater than would occur on the basis of chance. The number of persons who had previously suffered attacks is not large enough to obtain a statistically significant expectancy of cases from so small an incidence rate as prevails in smallpox; however, there is no question about the immunity of persons previously attacked by smallpox.

TABLE 20.—*Age incidence of smallpox in Detroit, Mich., and in a group of rural Michigan counties (no towns over 2,500 in 1930) which had no county health department—reported smallpox in 1929 and 1930* [1]

Age	Annual case rate per 100,000 population						Number of smallpox cases reported					
	Detroit (1,568,662) with large health department			Rural counties [2] without health departments			Detroit with large health department			Rural counties [2] without health departments		
	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female	Both sexes	Male	Female
All ages	6.9	9.1	4.6	102.2	111.0	92.1	218	149	69	377	218	159
Under 5	3.8	3.3	4.2	102.7	98.4	107.2	11	5	6	37	18	19
5–9	6.1	6.0	6.1	138.7	169.7	107.5	18	9	9	57	35	22
10–14	3.0	3.0	3.0	162.4	169.6	155.1	8	4	4	70	37	33
15–19	5.3	8.4	2.3	179.8	166.0	196.2	13	10	3	68	34	34
20–24	15.8	23.9	7.9	89.0	123.0	45.9	48	36	12	22	17	5
25–34	9.5	13.5	4.9	78.7	67.4	91.3	63	48	15	31	14	17
35–44	4.7	7.3	1.3	82.5	105.6	56.7	26	23	3	37	25	12
45–54	6.8	6.1	7.7	72.4	89.7	52.2	20	10	10	30	20	10
55 and over	4.9	3.7	6.1	29.8	40.6	15.4	11	4	7	18	14	4

[1] Data from annual reports of the Michigan State Department of Health.
[2] The counties included are Arenac, Baraga, Benzie, Clare, Gladwin, Huron, Keweenaw, Lake, Leelanau, Luce, Mackinac, Newaygo, Oceana, Ontonagon, Osceola, and Sanilac. The population in 1930 for the 16 counties was 184,514. Counties having health departments on Jan. 1, 1931 (15), are excluded, as they presumably existed for at least a part of the 2-year period covered.

AGE AND SEX INCIDENCE OF SMALLPOX AS REPORTED TO THE MICHIGAN STATE HEALTH DEPARTMENT

In the absence of sufficient data from the surveyed group, reported smallpox cases in Michigan (11) are used to indicate in more detail the age curve of the disease. Since the age incidence varies from place to place and from year to year, because of variation in the vaccinal status of the population, several curves are given. Table 20 shows the data for Detroit and for a group of rural counties which were without full-time county health officers, and none of which contained a town as large as 2,500. Presumably these rural counties

were low in vaccinal history and presumably Detroit was reasonably well vaccinated, for about three-fourths of its population were vaccinated in 1924 and a considerable number of vaccinations are done annually (8, p. 42). The smallpox data are for the years 1929 and 1930.

Considering first the actual incidence at all ages, the rural rate is 15 times the Detroit rate; among children under 20 years the average in the rural areas (146 per 100,000) is 32 times that in Detroit (4.6). At 20–24 years, when there is a high peak in Detroit, the rural rate is more than 5 times the Detroit rate. Reporting is probably more complete in Detroit than in the rural counties, and so the observed differences are an understatement rather than an overstatement of the facts.

Figure 10 is designed to compare the age curves rather than the actual incidence, its scales being arranged to make the curves comparable on a relative basis. In the presumably unvaccinated rural areas, smallpox has its highest incidence among persons under 20 years of age, with a decline as age increases beyond that point. In Detroit the rates are low under 20 years and among older people; the relatively high rate for young adults is presumably due to the migration of unvaccinated persons from rural areas to work in Detroit.

The city of Flint (156,000 population) had an epidemic of 515 cases of smallpox in 1929 and 98 cases in 1930. During 1929, in connection with the campaign to stamp out the disease, there were about 10,000 vaccinations, which was 4 or 5 times as many as in normal years (9). Although the ages of persons vaccinated are not reported, it is probably safe to assume that a higher proportion of school children were vaccinated than persons in other age groups. Table 21 and figure 10 show age-specific smallpox case rates for each of the years 1929 and 1930. All the rates are lower in 1930—the comparison of the relative age incidence is the point under consideration. In 1929 the highest rates are for the school ages, but in 1930 (after the vaccinations of 1929) the school ages have lower rates than adults. The young adult peak suggests the possibility of some epidemic in a factory that did not spread to other places or to the schools.

Edwardes (14, p. 101) gives smallpox cases in different age groups in vaccinated and unvaccinated populations in certain European countries and shows the reversal of smallpox from a childhood disease to one of the older ages by the practice of vaccination.

SMALLPOX MORTALITY IN THE UNITED STATES

Since there were no smallpox deaths among the 17 cases in the surveyed families, mortality data for the general population are used. In the continental United States there were 91,189 cases (white and colored) of smallpox reported in 1929 and 1930, an annual inci-

dence rate of 37.1 per 100,000. The total of 347 deaths registered [15] gives an annual mortality of 1.41 per million, and a case fatality of 0.38 percent.[16] To express it in another way, there were 263 cases reported for each death registered. Evidently there was little smallpox of the malignant type in these years.

Table 22 and figure 11 show by age and sex the mortality from smallpox in the white population of the registration States. The mortality curve shows the usual high rates in the very young and the very old, and does not resemble any of the case incidence curves that are shown in figure 10. At both extremes of life the mortality of males

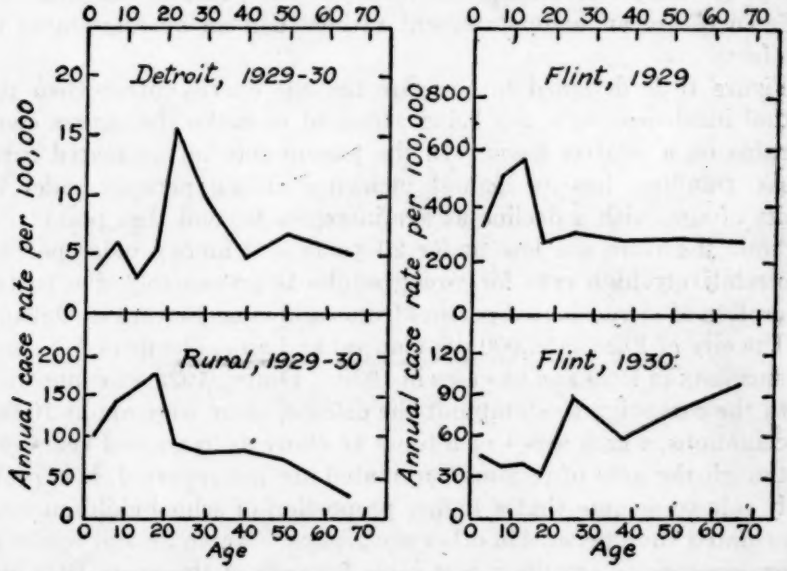

FIGURE 10.—Age incidence of smallpox as reported to health departments in certain localities in Michigan, 1929–30. (Rural includes 16 counties with no town over 2,500 in population and no county health department. See footnote to table 20 for names of counties. Scales are so made that the rate for all ages represents an interval on the vertical rate scale that corresponds to approximately 20 years on the horizontal age scale.)

exceeds that of females, but there is little difference between the sexes among young and middle-aged adults.

REACTIONS FOLLOWING VACCINATION

Of the 1,209 vaccinations in the canvassed group, 72, or 6 percent, were reported as being accompanied by reactions of sufficient severity to cause loss of time from school, work, or other usual activities; and of these, 51, or 4.2 percent of the total vaccinations, caused the patient to remain in bed for 1 or more days. Table 23 shows the data by age.

[15] Mortality Statistics (7) supplemented by State reports (12) for South Dakota in 1929 and Texas in 1929 and 1930.

[16] The Michigan reports (11) show for 1929 and 1930 a total of 4,785 cases, or an annual incidence rate of 49.4 per 100,000, with 18 deaths, or an annual mortality of 1.86 per million, and a case fatality of 0.38 percent.

The higher percentages for the school ages may represent less reluctance to remain away from school rather than more frequent reactions.

The period of disability was short, 40 percent of the disabling cases involving loss of 1 or 2 days only, and 81 percent involving not more than 5 days. Of the bed cases, 51 percent were in bed for 1 or 2 days only, and 84 percent for 3 days or less, the average time in bed for bed cases being 2.7 days.

WHERE VACCINATIONS WERE DONE AND THE SERVICE RECEIVED

Of all vaccinations during the 12-month study, 42 percent were done in public clinics or by school physicians. This may be contrasted with 57 percent of diphtheria immunizations, 52 percent of

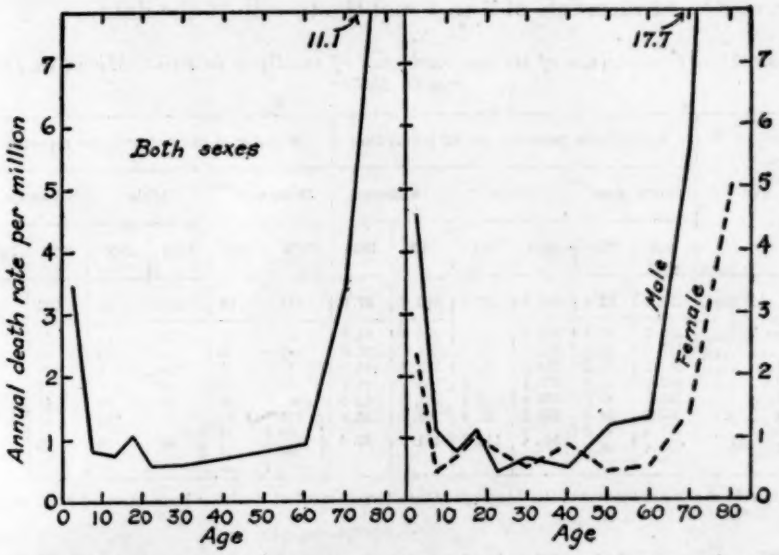

FIGURE 11.—Smallpox mortality at specific ages for each sex—white population in the registration States, 1929-30. (Scale is so made that the rate for all ages of both sexes represents an interval on the vertical rate scale that corresponds to approximately 20 years on the horizontal age scale.)

typhoid, and 36 percent of scarlet fever immunizations, and 3 percent of cases given cold vaccine. Of the smallpox vaccinations done by public clinics, 91 percent were free, and in the others a fee of some kind was paid, including those with a nominal charge only.

Considering the percentage of vaccinations at different ages that were done in public clinics or by school physicians, the figure rises from 37 percent under 5 years to 48 percent at 5 to 9 years and to a maximum of 60 percent at 10 to 14 years. After the peak the percentage declines to 41 percent at 15 to 19 years, 29 percent at 20 to 44 years, and 19 percent among persons 45 years old and over.

Of all the vaccinations, 2.2 percent were reported as done by specialists (nearly all by pediatricians), and 6.6 percent had a visiting nurse on the case, presumably to urge that the vaccination be done.

Of all the vaccinations, 81.3 percent had only one call to the physician, 16.3 percent had two calls, and 2.4 percent had three or more calls. There was an average of 1.24 calls per vaccination.

IV. SUMMARY

Information on the history of smallpox vaccinations and cases at any time and more detailed records of vaccinations and other medical care during a 12-month period between 1928 and 1931 were obtained on 8,758 white families in 130 localities in 18 States. Each family was visited at intervals of 2 to 4 months to collect the data.

TABLE 21.—*Comparison of the age incidence of smallpox in Flint, Mich., in 1929 and in 1930* [1]

Age	Annual case rates per 100,000 population						Number of cases of smallpox reported					
	Both sexes		Male		Female		Both sexes		Male		Female	
	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930	1929	1930
All ages	329.1	62.6	344.3	67.2	312.4	57.6	515	98	282	55	233	43
Under 5	319.6	47.3	325.1	11.6	313.9	84.5	54	8	28	1	26	7
5–9	507.5	37.1	452.0	36.7	564.5	37.6	82	6	37	3	45	3
10–14	557.2	38.2	530.0	31.2	583.2	44.9	73	5	34	2	39	3
15–19	262.0	31.8	373.4	17.0	164.1	44.7	33	4	22	1	11	3
20–29	299.7	89.0	316.1	112.9	281.5	62.6	101	30	56	20	45	10
30–44	267.5	58.3	267.1	57.2	268.0	59.6	101	22	56	12	45	10
45–54	277.4	78.2	348.4	113.7	181.2	57.6	39	11	49	16	22	7
55 and over	263.4	98.8					32	12				

[1] Data from annual reports of the Michigan State Department of Health. Population of Flint in 1930 was 156,492.

The surveyed families include representation from nearly all geographic sections, from rural, urban, and metropolitan areas, from all income classes, and of both native- and foreign-born persons. The proportions of these various elements included are not identical with those in the population of the United States, but the variations are not generally large. In other respects also the surveyed group is not dissimilar to families in the general white population of the United States.

Considering the whole group, about 70 percent of adults gave a history of smallpox vaccination or case at some time; 65 percent gave a history of vaccination, and 5 percent gave a history of an attack (fig. 1).

Only 10 to 20 percent of the children had been vaccinated before the age of school entrance; most of the vaccinations were done be-

tween 5 and 10 years of age and 85 to 90 percent of adults had not been vaccinated within 7 years (fig. 1).

Males and females were not significantly different with respect to smallpox vaccination and case histories (fig. 2).

Among persons living in cities, larger percentages had been vaccinated and smaller percentages had suffered attacks of smallpox than in rural areas (fig. 3). This statement is true for each of four geographic regions included in the study (fig. 5).

TABLE 22.—*Annual smallpox mortality at specific ages for each sex—white persons in the registration States,*[1] *1929–30*

	All ages	Age										
		Under 5	5–9	10–14	15–19	20–24	25–34	35–44	45–54	55–64	65–74	75 and over
Annual death rate per million:												
Both sexes	1.31	3.49	0.81	0.74	1.09	0.61	0.63	0.71	0.84	0.93	3.62	11.07
Male	1.67	4.57	1.13	.78	1.14	.45	.69	.53	1.19	1.29	5.74	17.72
Female	.94	2.36	.48	.70	1.04	.76	.56	.90	.46	55	1.42	5.02
Number of deaths:												
Both sexes	273	66	17	15	21	11	20	21	19	14	31	38
Male	176	44	12	8	11	4	11	8	14	10	25	29
Female	97	22	5	7	10	7	9	13	5	4	6	9

[1] Registration States included all except Texas and South Dakota in 1929 and all except Texas in 1930

TABLE 23.—*Proportion of smallpox vaccinations which caused disability for one or more days (inability to pursue usual activities) and which caused the person to remain in bed for one or more days*

	All ages[1]			Both sexes					
	Both sexes	Male	Female	Under 5	5–9	10–14	15–19	20–44	45 and over
Total number of vaccinations	1,209	591	618	232	402	199	90	216	68
Number with disability	72	37	35	5	33	17	5	9	2
Percentage with disability	6.0	6.3	5.7	2.2	8.2	8.5	5.5	4.2	2.9
Number in bed	51	29	22	5	23	12	2	7	1
Percentage in bed	4.2	4.9	3.6	2.2	5.7	6.0	2.2	3.2	1.5

[1] All ages includes 2 of unknown age.

Vaccinations during the 12 months of the morbidity study amounted to 31 per 1,000 population of all ages; under 20 years the rate was 49 per 1,000. These rates seem to be about the same as had occurred in preceding years, as judged by the history data.

Vaccinations were more frequent in low- and high-income groups than in the intervening economic classes (fig. 7).

About 74 percent of the vaccinations during the study year were done in 10 percent of the localities. In every locality where large numbers of vaccinations occurred there was an epidemic or threatened epidemic of smallpox. Epidemics in some localities, however, failed to stimulate large numbers of vaccinations.

Of the 17 cases of smallpox that occurred in the observed population, 16 were among persons never vaccinated, a rate of 96 per 100,000, as compared with 1 case (vaccinated 40 years previously), or a rate of 5 per 100,000 among persons who had been vaccinated at any time.

Smallpox rates at specific ages based on reported cases in rural and urban parts of Michigan indicate that the prevalence of vaccination profoundly modifies the age incidence of the disease (fig. 10).

The relative age curve of smallpox mortality is radically different from that of the case incidence (fig. 11).

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B. OTHER REFERENCES

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(9) Annual reports of the Health Department of Flint, Mich. (Typewritten copies supplied to the Library of the U. S. Public Health Service.)

(10) Annual report of the Illinois State Department of Health for the year ending June 30, 1930.

(11) Annual reports of the Michigan State Department of Health.

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PUBLIC HEALTH SERVICE PUBLICATIONS

A List of Publications Issued During the Period July–December 1935

There is printed herewith a list of publications of the United States Public Health Service issued during the period July–December 1935.

The most important articles that appear each week in the PUBLIC HEALTH REPORTS are reprinted in pamphlet form, making possible a wider and more economical distribution of information that is of especial value and interest to public health workers and the general public.

All of the publications listed below except those marked with an asterisk (*) are available for free distribution and as long as the supply lasts may be obtained by addressing the Surgeon General, United States Public Health Service, Washington, D. C. Those publications marked with an asterisk are not available for free distribution but, unless stated to be "out of print", may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., *at the prices noted.* (No remittances should be sent to the Public Health Service.)

Periodicals

Public Health Reports (weekly), July–December, vol. 50, nos. 27–52, pages 891 to 1848.

Venereal Disease Information (monthly), July–December, vol. 16, nos. 7–12, pages 223 to 432.

Reprints from the Public Health Reports

1693. Report of the Committee on Milk, Conference of State and Provincial Health Authorities, 1935. July 19, 1935. 4 pages.

1694. Milk-sanitation ratings of cities. Cities for which milk-sanitation ratings of 90 percent or more were reported by the State milk-sanitation authorities during the period July 1, 1933, to June 30, 1935. July 26, 1935. 3 pages.

1695. Malaria epidemic in Aurora, Ohio. By R. N. Hoyt and R. D. Worden. July 5, 1935. 3 pages.

1696. Roentgenological appearances in silicosis and the underlying pathological lesions. Report by a committee composed of H. K. Pancoast, E. P. Pendergrass, A. R. Riddell, A. J. Lanza, Wm. J. McConnell, R. R. Sayers, H. L. Sampson, and L. U. Gardner. August 2, 1935. 8 pages.

1697. The control of communicable diseases. Report of a committee of the American Public Health Association. August 9, 1935. 61 pages.

1698. Dedication and opening of the Lexington Narcotic Farm. By W. L. Treadway. August 2, 1935. 5 pages.

1699. Public Health Service publications. A list of publications issued during the period January–June 1935. August 2, 1935. 4 pages.

1700. Control of rabies in New York City. By Robert Olesen. August 16, 1935. 20 pages.

1701. Height and weight of children of the depression poor. Health and depression studies no. 2. By Carroll E. Palmer. August 16, 1935. 7 pages.

1702. Acute response of guinea pigs to vapors of some new commercial organic compounds. VIII. Butanone. By F. A. Patty, H. H. Schrenk, and W. P. Yant. September 6, 1935. 12 pages.

1703. The maternity nursing service of a bicounty health department. Brunswick-Greensville health administration studies no. 5. Prepared by Pearl McIver. September 20, 1935. 16 pages.

1704. Directory of whole-time county health officers, 1935. September 20, 1935. 10 pages.

1705. The blacktongue-preventive value of 7 foodstuffs. By W. H. Sebrell, G. A. Wheeler, and D. J. Hunt. September 27, 1935. 9 pages.

1706. The accuracy of certified causes of death. Its relation to mortality statistics and the International List. (Report of the Committee, American Public Health Association.) September 13, 1935. 45 pages.

1707. Dust storms and their possible effect on health. With special reference to the dust storms in Kansas in 1935. By Earle G. Brown, Selma Gottlieb, and Ross L. Laybourn. October 4, 1935. 15 pages; 8 plates.

1708. Milk control and the United States Supreme Court. By James A. Tobey. October 4, 1935. 6 pages.

1709. A nonflammable pyrethrum spray for use in airplanes. By C. L. Williams and W. C. Dreessen. October 11, 1935. 4 pages.

1710. Age incidence of specific causes of illness. Based on records for 9,000 families in 18 States visited periodically for 12 months, 1928–1931. By Selwyn D. Collins. October 11, 1935. 25 pages.

1711. Cultivation of the virus of Rocky Mountain spotted fever in the developing chick embryo. By Ida A. Bengtson and R. E. Dyer. October 25, 1935. 10 pages; 3 plates.

1712. The urinary excretion of silica by persons exposed to silica dust. By J. J. Bloomfield, R R. Sayers, and F. H. Goldman. March 29, 1935. 4 pages.

1713. Disabling illness among industrial employees in 1934 as compared with earlier years. By Dean K. Brundage. November 1, 1935. 13 pages.

1714. Extent of rural health service in the United States, December 31, 1930–December 31, 1934. November 1, 1935. 16 pages.

1715. Studies of sewage purification. III. The clarification of sewage—A review. By Emery J. Theriault. November 8, 1935. 15 pages.

1716. Physical condition and unemployment. By Harold S. Diehl. November 15, 1935. 9 pages.

1717. Microscopic appearance of experimentally produced dust nodules in the peritoneum. By J. W. Miller and R. R. Sayers. November 15, 1935. 10 pages; 6 plates.

1718. Further studies of the effect of radium upon bacteria. By R. R. Spencer. November 22, 1935. 14 pages; 4 plates.
1719. A technique which completely excludes air contamination of bacterial cultures. By R. R. Spencer. November 22, 1935. 2 pages; 1 plate.
1720. Influenza and pneumonia mortality in a group of about 95 cities in the United States during four minor epidemics, 1930–35, with a summary for 1920–35. By Selwyn D. Collins and Mary Gover. November 29, 1935. 21 pages.
1721. Studies on the minimal threshold of the dental sign of chronic endemic fluorosis (mottled enamel). By H. Trendley Dean and Elias Elvove. December 6, 1935. 11 pages.
1722. Job analysis of a rural health officer. Brunswick-Greensville health administration studies no. 6. Prepared by J. O. Dean. December 13, 1935. 12 pages.
1723. Cost of local enforcement of the United States Public Health Service milk ordinance. By A. W. Fuchs and L. C. Frank. December 13, 1935. 5 pages.
1724. State and insular health authorities, 1935. Directory, with data as to appropriations and publications. December 20, 1935. 18 pages.

Supplements to the Public Health Reports

115. The size distribution of industrial dusts. By J. J. Bloomfield. 1935. 9 pages.
116. Some Public Health Service publications suitable for general distribution. 1935. 23 pages.
117. The notifiable diseases. Prevalence in States, 1934. 1935. 12 pages.

Public Health Bulletins

217. The determination and control of industrial dust. By J. J. Bloomfield and J. M. DallaValle. April 1935. 167 pages.
218. Studies in illumination. IV. Daylight in buildings. A study of the effect of the height and width of windows and of the reflecting power of the walls and ceiling upon the natural illumination within a building. By James E. Ives, Frederick L. Knowles, and Lewis R. Thompson. April 1935. 52 pages.
220. Public Health Service milk ordinance and code. July 1935. 114 pages.
221. Anthraco-silicosis among hard coal miners. Engineering studies by J. J. Bloomfield and J. M. DallaValle; medical studies by R. R. Jones and Waldemar C. Dreessen; statistical analysis by Dean K. Brundage and Rollo H. Britten. With sections on autopsy material by J. W. Miller and on silica in the urine and in lung specimens by F. H. Goldman. December 1935. 114 pages; 45 plates.

National Institute of Health Bulletin

165. I. A method for quantitating neuromuscular irritability. The effect of certain drugs on the neuromuscular apparatus. By Maurice I. Smith. II. The pharmacologic action of some alcoholic phosphoric esters. By Maurice I. Smith. June 1935. 29 pages.

Unnumbered Publication

Index to Public Health Reports, vol. 50, part 1 (January–June 1935). 1935. 24 pages.

THE PICTURE OF HEART DISEASE MORTALITY OBTAINED FROM VITAL STATISTICS IN WASHINGTON, D. C., DURING 1932.—A CORRECTION

In the article with the above title, which appeared in the Public Health Reports for March 20, 1936, the first part of the last sentence in the paragraph at the bottom of page 286 should read, "When it is considered that few deaths from congenital heart disease" etc., instead of, "When it is considered that most deaths" etc.

DEATHS DURING WEEK ENDED MARCH 28, 1936

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Mar. 28, 1936	Corresponding week, 1935
Data from 86 large cities of the United States:		
Total deaths	10,192	8,612
Deaths per 1,000 population, annual basis	14.2	12.0
Deaths under 1 year of age	674	571
Deaths under 1 year of age per 1,000 estimated live births	61	52
Deaths per 1,000 population, annual basis, first 13 weeks of year	13.8	12.8
Data from industrial insurance companies:		
Policies in force	68,251,415	67,650,314
Number of death claims	14,510	13,584
Death claims per 1,000 policies in force, annual rate	11.1	10.5
Death claims per 1,000 policies, first 13 weeks of year, annual rate	11.0	10.9

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers

Reports for weeks ended Apr. 4, 1936, and Apr. 6, 1935

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Apr. 4, 1936, and Apr. 6, 1935

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935
New England States:								
Maine			13	1	195	92	1	0
New Hampshire				19	35	1	0	0
Vermont	1				799	7	0	0
Massachusetts	4	9			1,109	520	13	1
Rhode Island		2			48	242	0	1
Connecticut	1	4	24	5	50	1,191	2	1
Middle Atlantic States:								
New York	57	38	[1] 17	[1] 7	2,909	2,983	21	27
New Jersey	13	29	26	16	324	1,562	5	1
Pennsylvania	31	49			721	6,227	14	4
East North Central States:								
Ohio	28	35	20	16	424	1,520	7	13
Indiana	11	13	116	41	28	370	6	9
Illinois	43	37	61	21	24	2,947	10	23
Michigan	11	13	12	13	110	3,887	4	1
Wisconsin	2	8	69	36	111	1,729	1	4
West North Central States:								
Minnesota	7	5			361	1,056	2	1
Iowa	8	10	5	6	2	1,889	1	5
Missouri	24	23	957	56	23	649	6	8
North Dakota		8	12	3		24	0	0
South Dakota	2	2		2	1	32	0	1
Nebraska	5	4	4		108	302	1	5
Kansas	15		81	3	9	1,726	1	2
South Atlantic States:								
Delaware	6	1			21	22	1	0
Maryland [1]	6	3	80	17	292	61	9	7
District of Columbia	11	18	1	5	45	72	7	10
Virginia	7	14	909		151	938	10	5
West Virginia	6	15	229	120	30	440	9	1
North Carolina [1]	18	10	107	8	64	342	10	6
South Carolina	2	4	303	233	17	49	8	1
Georgia [1]	10	2	657				3	1
Florida [1]	3		12	1	18	77	1	1
East South Central States:								
Kentucky	8	4	202	36	77	738	48	1
Tennessee	6	4	552	78	70	82	10	2
Alabama [1]	17	6	1,823	144	50	441	7	3
Mississippi [1]	4	3					0	3

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Apr. 4, 1936, and Apr. 6, 1935—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935
West South Central States:								
Arkansas	9	6	367	19	7	88	3	0
Louisiana	9	14	606	16	67	138	3	1
Oklahoma [4]	23	13	323	124	21	198	9	5
Texas [3]	42	56	902	614	423	163	8	0
Mountain States:								
Montana		6	39	218	15	601	2	2
Idaho			4	4	15	33	0	0
Wyoming						174	0	0
Colorado	10	5			25	381	2	1
New Mexico	3	6	85	14	54	38	0	2
Arizona	1	1	90	21	135	63	1	0
Utah [7]			3		21	6	0	0
Pacific States:								
Washington	2	6	57	2	362	262	1	1
Oregon	1		93	81	269	210	2	2
California	26	27	351	73	2,640	1,313	7	12
Total	493	508	9,172	2,073	12,280	35,976	256	174
First 14 weeks of year	8,475	9,953	108,276	93,384	117,137	352,180	3,250	1,826

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935
New England States:								
Maine	2	0	7	13	0	0	4	5
New Hampshire	0	0	9	7	0	0	2	0
Vermont	0	0	12	12	0	0	0	0
Massachusetts	0	0	368	261	0	0	2	2
Rhode Island	0	0	25	6	0	0	0	0
Connecticut	0	1	102	130	0	0	5	0
Middle Atlantic States:								
New York	1	0	1,159	1,271	0	0	9	4
New Jersey	0	1	522	171	0	0	2	0
Pennsylvania	0	1	639	757	0	0	7	9
East North Central States:								
Ohio	0	0	463	877	0	0	39	3
Indiana	0	0	264	204	5	0	0	0
Illinois	1	1	885	1,197	8	1	10	5
Michigan	0	1	347	247	0	0	3	5
Wisconsin	1	0	557	462	9	26	1	2
West North Central States:								
Minnesota	0	1	383	225	5	4	0	0
Iowa	0	0	221	50	30	8	2	1
Missouri	0	0	115	60	7	2	2	3
North Dakota	0	0	55	74	3	0	4	0
South Dakota	0	1	77	10	27	2	0	0
Nebraska	0	1	213	42	34	23	0	0
Kansas	0	0	362	57	35	23	0	1
South Atlantic States:								
Delaware	0	0	3	20	0	0	0	0
Maryland [1]	1	0	60	126	0	0	4	2
District of Columbia	0	1	16	113	0	0	1	0
Virginia	0	0	51	38	0	2	3	2
West Virginia	0	0	55	64	0	0	2	4
North Carolina [2]	1	3	32	29	4	1	4	11
South Carolina	0	0	2	5	0	0	0	1
Georgia [3]	0	0	15	7	0	0	0	2
Florida [3]	0	0	7	3	0	2	6	4
East South Central States:								
Kentucky	0	0	43	37	1	0	4	1
Tennessee	0	0	29	18	0	0	9	7
Alabama [2]	0	0	7	11	1	10	0	7
Mississippi [2]	1	0	6	3	0	0	0	2

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Apr. 4, 1936, and Apr. 6, 1935—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935	Week ended Apr. 4, 1936	Week ended Apr. 6, 1935
West South Central States:								
Arkansas	0	0	18	3	0	1	2	0
Louisiana	0	1	10	7	0	1	2	12
Oklahoma [4]	0	0	36	13	0	0	6	2
Texas [1]	0	3	59	60	5	105	2	20
Mountain States:								
Montana	0	0	101	7	6	3	0	0
Idaho	0	0	53	11	4	0	0	0
Wyoming	0	0	67	17	3	11	0	1
Colorado	0	0	193	277	10	16	0	0
New Mexico	0	0	90	16	0	3	0	3
Arizona	0	0	25	32	0	1	2	0
Utah [2]	0	0	71	92	1	0	0	1
Pacific States:								
Washington	0	0	106	57	5	15	1	2
Oregon	1	0	43	76	4	3	8	3
California	1	5	338	240	2	3	0	3
Total	10	21	8,319	7,515	209	261	148	130
First 14 weeks of year	272	356	109,573	99,950	3,213	2,749	1,563	1,796

[1] New York City only.
[2] Week ended earlier than Saturday.
[3] Typhus fever, week ended Mar. 28, 1936, 10 cases, as follows: North Carolina, 1; Georgia, 1; Florida, 1; Alabama, 3; Texas, 4.
[4] Exclusive of Oklahoma City and Tulsa.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
December 1935										
Vermont	-------	4	1	-------	534	-------	4	57	0	2
January 1936										
Vermont	-------	2	-------	-------	689	-------	2	68	1	1
February 1936										
Hawaii Territory	2	10	1,126	-------	8	-------	0	-------	0	4
Mississippi	5	18	35,092	1,473	825	123	0	65	0	8
Missouri	45	131	1,970	12	121	1	5	1,138	55	18
Texas	48	250	2,565	1,031	-------	15	1	429	-------	29
Vermont	-------	-------	-------	-------	1,370	-------	-------	78	0	1
March 1936										
Arkansas	14	36	2,289	50	33	26	1	65	4	3
Delaware	3	5	4	-------	188	-------	0	18	0	0
District of Columbia	25	99	16	-------	188	-------	0	104	0	1
Indiana	18	68	222	-------	47	-------	0	1,187	22	5
Iowa	13	46	36	1	12	-------	1	978	78	10
Nebraska	4	29	13	-------	202	-------	4	841	139	0
New Mexico	8	12	104	-------	212	3	-------	346	2	7

December 1935

Vermont:	Cases
Chicken pox	501
German measles	72
Mumps	173
Septic sore throat	1
Undulant fever	1
Whooping cough	191

January 1936

Vermont:	
Chicken pox	327
German measles	64
Mumps	177
Whooping cough	166

February 1936

Chicken pox:	
Hawaii Territory	51
Mississippi	585
Missouri	368
Vermont	144
Dengue:	
Mississippi	2
Dysentery:	
Hawaii Territory (amoebic)	3
Mississippi (amoebic)	44
Mississippi (bacillary)	241
Missouri	9
Epidemic encephalitis:	
Hawaii Territory	1
Missouri	2
German measles:	
Vermont	167
Hookworm disease:	
Mississippi	208
Leprosy:	
Hawaii Territory	2
Mumps:	
Hawaii Territory	8
Mississippi	2,079
Missouri	1,268
Vermont	120

February 1936—Continued

Ophthalmia neonatorum:	Cases
Missouri	1
Paratyphoid fever:	
Hawaii Territory	1
Texas	1
Puerperal septicemia:	
Mississippi	17
Rabies in animals:	
Mississippi	38
Missouri	3
Septic sore throat:	
Missouri	77
Trachoma:	
Mississippi	8
Missouri	4
Tularaemia:	
Missouri	1
Typhus fever:	
Hawaii Territory	1
Mississippi	1
Undulant fever:	
Hawaii Territory	1
Missouri	6
Vermont	3
Whooping cough:	
Hawaii Territory	51
Mississippi	549
Missouri	187
Vermont	70

March 1936

Actinomycosis:	
Iowa	1
Anthrax:	
Nebras a	1
Chicken pox:	
Arkansas	102
Delaware	50
District of Columbia	85
Indiana	263
Iowa	227
Nebraska	119
New Mexico	177

March 1936—Continued

Dysentery:	Cases
New Mexico (bacillary)	2
Epidemic encephalitis:	
District of Columbia	1
Iowa	2
German measles:	
Iowa	15
New Mexico	16
Mumps:	
Arkansas	387
Delaware	143
Indiana	372
Iowa	1,062
Nebraska	237
New Mexico	561
Ophthalmia neonatorum:	
New Mexico	1
Paratyphoid fever:	
New Mexico	1
Puerperal septicemia:	
New Mexico	3
Rabies in animals:	
Indiana	62
Septic sore throat:	
Iowa	3
Nebraska	1
New Mexico	9
Trachoma:	
New Mexico	1
Undulant fever:	
Iowa	4
Whooping cough:	
Arkansas	22
Delaware	27
District of Columbia	44
Indiana	162
Iowa	58
Nebraska	55
New Mexico	43

PLAGUE-INFECTED GROUND SQUIRREL IN VENTURA COUNTY, CALIF.

The Director of Public Health of California has reported that plague infection has been proved in a ground squirrel received at the laboratory on March 28, 1936. This squirrel was found south of Camarillo in Ventura County.

WEEKLY REPORTS FROM CITIES

City reports for week ended Mar. 28, 1936

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross-section of the current urban incidence of the communicable diseases listed in the table. Weekly reports are received from about 700 cities, from which the data are tabulated and filed for reference.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Maine:											
Portland	0	------	0	2	1	1	0	0	0	1	17
New Hampshire:											
Concord	0	------	0	0	0	0	0	2	0	0	9
Manchester	0	------	0	0	0	0	0	1	0	0	16
Nashua	0	------	--------	2	------	0	0	-------	0	0	--------
Vermont:											
Barre	------	------	--------	------	------	------	------	-------	------	------	--------
Burlington	0	------	0	48	0	0	0	0	0	1	8
Rutland	0	------	0	131	1	0	0	0	0	0	5
Massachusetts:											
Boston	6	------	1	380	40	63	0	18	1	27	256
Fall River	0	------	1	3	2	12	0	1	0	1	35
Springfield	0	------	0	2	1	15	0	1	1	12	48
Worcester	0	------	0	2	6	18	0	1	0	10	55
Rhode Island:											
Pawtucket	------	------	--------	------	------	------	------	-------	------	------	--------
Providence	0	------	1	40	9	21	0	2	0	3	66
Connecticut:											
Bridgeport	0	------	0	4	5	4	0	1	0	3	31
Hartford	0	------	0	5	7	6	0	2	0	0	61
New Haven	1	1	0	0	6	1	0	1	0	70	56
New York:											
Buffalo	1	------	0	20	19	71	0	12	0	10	161
New York	30	22	14	2,093	188	459	0	110	5	75	1,705
Rochester	0	------	3	0	7	2	0	1	0	0	91
Syracuse	0	------	1	59	4	13	0	0	0	8	47
New Jersey:											
Camden	0	2	1	0	6	4	0	2	0	2	34
Newark	0	6	1	8	17	191	0	11	0	20	137
Trenton	0	------	0	1	10	8	0	2	0	19	45
Pennsylvania:											
Philadelphia	5	14	12	531	61	64	0	22	2	54	376
Pittsburgh	3	6	5	38	51	128	0	7	0	20	253
Reading	0	------	0	2	2	3	0	1	0	1	36
Scranton	0	------	--------	0	------	3	0	-------	0	0	--------
Ohio:											
Cincinnati	11	------	2	17	24	13	0	10	0	2	180
Cleveland	1	125	5	53	44	72	0	17	1	83	258
Columbus	5	4	4	0	11	13	0	3	1	3	110
Toledo	1	------	0	49	6	2	0	9	0	9	86
Indiana:											
Anderson	1	------	1	0	2	7	0	0	0	6	15
Fort Wayne	3	------	2	0	8	9	0	0	0	0	32
Indianapolis	2	------	2	2	26	41	0	5	0	15	129
Muncie	1	------	0	0	1	1	0	0	0	0	9
South Bend	0	------	0	0	2	9	0	0	0	14	16
Terre Haute	1	------	0	0	0	8	0	0	0	0	25
Illinois:											
Alton	1	------	0	0	1	1	0	1	0	1	6
Chicago	17	17	13	17	80	283	0	41	1	193	795
Elgin	0	------	0	0	2	4	0	0	0	3	10
Moline	0	------	0	0	2	6	0	0	1	1	17
Springfield	1	------	1	0	3	21	0	0	0	0	26
Michigan:											
Detroit	3	12	7	30	58	138	1	23	2	178	389
Flint	0	----	0	0	0	11	0	2	0	26	34
Grand Rapids	0	------	2	10	2	12	0	2	0	8	33
Wisconsin:											
Kenosha	0	------	0	1	0	7	0	0	0	4	6
Madison	0	------	0	1	0	14	0	2	0	4	23
Milwaukee	0	2	2	2	6	95	0	4	0	79	106
Racine	0	------	0	------	1	21	0	2	0	3	15
Superior	0	------	0	0	2	24	0	0	0	1	10
Minnesota:											
Duluth	0	------	0	0	2	5	0	0	0	3	31
Minneapolis	2	------	2	209	19	149	0	0	0	11	129
St. Paul	0	------	0	135	7	57	0	1	1	4	70
Iowa:											
Cedar Rapids	0	------	--------	0	------	5	1	-------	0	4	--------
Davenport	0	------	--------	0	------	10	0	-------	0	0	--------
Des Moines	0	------	--------	0	------	11	0	-------	0	0	47
Sioux City	0	------	--------	0	------	14	18	-------	0	0	--------
Waterloo	0	------	--------	0	------	7	0	-------	0	1	--------

City reports for week ended Mar. 28, 1936—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Missouri:											
Kansas City	7	------	14	3	38	33	0	6	0	3	156
St. Joseph	0	------	4	0	13	5	0	3	0	0	69
St. Louis	10	8	1	2	23	72	0	8	0	9	267
North Dakota:											
Fargo	0	------	0	1	0	5	1	0	0	0	10
Grand Forks	0	------	------	0	------	1	0	------	0	0	------
Minot	0	------	0	0	0	4	0	0	0	0	3
South Dakota:											
Aberdeen	0	------	------	0	------	0	0	------	0	0	------
Sioux Falls	0	------	------	0	------	19	8	------	0	0	------
Nebraska:											
Omaha	4	------	1	5	13	127	11	1	0	0	76
Kansas:											
Lawrence	0	9	0	0	3	3	0	1	0	0	12
Wichita	1	------	0	1	5	18	0	0	0	1	28
Delaware:											
Wilmington	0	------	0	0	5	0	0	1	0	2	25
Maryland:											
Baltimore	1	29	6	110	37	39	0	19	1	27	251
Cumberland	1	------	------	0	------	3	0	------	0	0	------
Frederick	0	------	0	0	1	0	0	0	0	0	3
Dist. of Columbia:											
Washington	14	4	3	46	25	21	0	8	0	13	212
Virginia:											
Lynchburg	0	------	0	1	3	1	0	0	0	14	14
Norfolk	0	------	0	0	9	2	0	0	0	4	35
Richmond	2	------	2	3	2	28	0	1	0	0	52
Roanoke	0	------	1	0	6	5	0	1	0	0	22
West Virginia:											
Charleston	0	13	1	0	1	0	0	1	0	0	9
Huntington	0	0	------	0	------	1	0	------	0	0	------
Wheeling	0	------	1	20	4	1	0	1	0	0	18
North Carolina:											
Gastonia	0	------	1	0	1	1	0	0	0	0	8
Raleigh	------	------	------	------	------	------	------	------	------	------	------
Wilmington	0	------	0	0	2	0	0	0	0	0	8
Winston-Salem	1	------	0	122	2	2	0	1	0	0	9
South Carolina:											
Charleston	0	60	2	0	6	4	0	2	0	5	34
Columbia	------	------	------	------	------	------	------	------	------	------	------
Florence	1	------	0	0	3	0	0	0	0	0	13
Greenville	0	------	0	13	2	0	0	0	0	0	20
Georgia:											
Atlanta	4	26	4	1	7	11	0	5	0	0	107
Brunswick	0	------	0	0	2	0	0	1	0	0	7
Savannah	2	13	2	0	3	3	0	3	0	0	42
Florida:											
Miami	0	9	3	3	3	1	0	4	1	2	49
Tampa	0	4	3	1	3	2	0	4	0	0	39
Kentucky:											
Ashland	1	------	0	0	0	0	0	0	0	1	------
Covington	0	------	0	4	3	4	0	0	0	0	22
Lexington	0	------	0	0	6	0	0	2	0	1	21
Louisville	2	40	3	8	15	26	0	3	0	6	92
Tennessee:											
Knoxville	2	------	2	36	3	2	0	1	1	0	32
Memphis	1	------	10	2	27	14	0	12	0	6	143
Nashville	0	------	6	1	11	8	0	5	1	0	74
Alabama:											
Birmingham	0	89	12	0	25	3	0	4	1	0	118
Mobile	0	11	4	1	3	0	0	1	0	0	26
Montgomery	0	7	------	2	------	2	0	------	0	1	------
Arkansas:											
Fort Smith	1	------	------	0	------	0	0	------	0	0	------
Little Rock	2	------	0	1	10	2	0	------	0	0	10
Louisiana:											
Lake Charles	0	------	1	0	2	0	0	0	0	0	6
New Orleans	2	80	24	26	37	9	0	15	0	80	223
Shreveport	0	------	0	17	15	2	0	4	0	0	58
Oklahoma:											
Oklahoma City	1	26	0	0	18	6	0	0	0	2	54
Texas:											
Dallas	3	2	2	57	9	3	0	6	0	2	75
Fort Worth	1	------	1	0	10	9	0	6	0	0	65
Galveston	2	------	0	16	6	3	0	0	0	0	18
Houston	7	------	6	8	23	1	0	6	0	0	129
San Antonio	2	------	3	9	8	2	0	5	0	0	65

City reports for week ended Mar. 28, 1936—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Montana:											
Billings	0	------	0	0	0	3	0	1	0	4	6
Great Falls	0	------	0	0	1	5	0	0	1	4	8
Helena	0	------	0	0	0	0	0	0	0	0	5
Missoula	0	------	0	0	0	10	0	0	0	0	3
Idaho:											
Boise	0	------	0	26	0	4	0	0	0	0	7
Colorado:											
Colorado Springs	0	------	0	0	2	8	0	3	0	4	12
Denver	3	------	0	8	10	14	0	3	0	18	109
Pueblo	0	------	0	0	0	33	0	1	0	7	6
New Mexico:											
Albuquerque	0	2	1	0	1	16	1	2	0	1	16
Utah:											
Salt Lake City	0	------	0	3	6	65	4	4	0	1	40
Nevada:											
Reno	------	------	------	------	------	------	------	------	------	------	------
Washington:											
Seattle	0	------	2	157	4	15	1	6	0	6	107
Spokane	0	4	4	4	0	14	0	1	0	4	35
Tacoma	0	------	0	19	9	6	0	0	0	0	40
Oregon:											
Portland	1	7	5	99	15	8	0	1	0	1	104
Salem	0	23	------	7	------	1	1	------	0	1	------
California:											
Los Angeles	5	52	4	612	9	55	0	18	0	28	280
Sacramento	2	2	1	12	3	2	0	0	0	10	30
San Francisco	1	4	0	410	6	82	0	4	0	34	138

State and city	Meningococcus meningitis		Poliomyelitis cases
	Cases	Deaths	
Massachusetts:			
Boston	3	5	0
Springfield	1	0	0
Rhode Island:			
Providence	2	1	0
Connecticut:			
New Haven	2	0	0
New York:			
New York	35	7	0
New Jersey:			
Newark	2	0	0
Pennsylvania:			
Philadelphia	5	2	0
Pittsburgh	1	1	0
Ohio:			
Cincinnati	5	0	0
Cleveland	3	1	0
Columbus	1	1	0
Indiana:			
Indianapolis	1	0	0
Illinois:			
Chicago	8	2	0
Michigan:			
Detroit	1	4	0
Minnesota:			
Duluth	1	0	0
Iowa:			
Des Moines	2	0	0
Missouri:			
St. Joseph	2	2	0
Nebraska:			
Omaha	0	1	1
Maryland:			
Baltimore	13	10	0
District of Columbia:			
Washington	10	4	0
Virginia:			
Richmond	2	0	0
Roanoke	1	1	0
South Carolina:			
Winston-Salem	1	0	0
Charleston	14	2	0
Greenville	0	1	0
Georgia:			
Atlanta	4	1	0
Savannah	1	1	0
Florida:			
Tampa	1	2	0
Kentucky:			
Covington	3	2	0
Louisville	2	0	0
Tennessee:			
Knoxville	0	1	0
Memphis	1	1	0
Alabama:			
Birmingham	1	0	0
Arkansas:			
Fort Smith	1	0	0
Louisiana:			
New Orleans	2	0	0
Oklahoma:			
Oklahoma City	1	0	0
Texas:			
Galveston	1	1	0
Houston	4	4	0
San Antonio	1	0	0
California:			
Los Angeles	4	0	1
San Francisco	1	0	0

Epidemic encephalitis.—Cases: Boston, 1; Philadelphia, 1; Denver, 1.
Pellagra.—Cases: Atlanta, 2; Savannah, 1; Dallas, 1; Albuquerque, 1: Los Angeles, 6; San Francisco, 1.
Typhus fever.—Cases: Galveston, 1.

FOREIGN AND INSULAR

CANADA

Provinces—Communicable diseases—2 weeks ended March 21, 1936.—During the 2 weeks ended March 21, 1936, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis					6				2	8
Chicken pox		19	15	216	460	26	73	25	109	943
Diphtheria	1	4	2	43	14	12	3	3	5	87
Dysentery				3	2					5
Erysipelas				9	7	4	5		4	29
Influenza		21	1		192	36	81		669	1,000
Lethargic encephalitis					1					1
Measles		72	7	4,170	7,417	935	1,321	175	1,644	15,741
Mumps		7			1,138	81	185	73	252	1,736
Paratyphoid fever					1					1
Pneumonia		1			90				24	115
Poliomyelitis				2						2
Scarlet fever	1	86	7	190	635	89	25	76	60	1,119
Smallpox								22		22
Trachoma						2			4	6
Tuberculosis	6	3	19	126	67	31	1	4	22	279
Typhoid fever	1		4	31	4	7	4	1	2	54
Undulant fever				1	8					9
Whooping cough		40	16	81	452	54	45	23	83	794

JAMAICA

Communicable diseases—4 weeks ended March 21, 1936.—During the 4 weeks ended March 21, 1936, cases of certain communicable diseases were reported in Kingston, Jamaica, and in the island outside of Kingston, as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Cerebrospinal meningitis	2	3	Puerperal fever		1
Chicken pox	3	50	Scarlet fever		1
Dysentery	12	5	Tuberculosis	42	117
Leprosy	1	10	Typhoid fever	11	150

JAPAN

Infectious diseases—1933–34.—During the years 1933 and 1934, certain infectious diseases were reported in Japan as follows:

Disease	1933		1934	
	Cases	Deaths	Cases	Deaths
Cerebrospinal meningitis	359	219	1,191	650
Cholera	628			
Diphtheria	28,518	5,270	30,110	5,089
Dysentery	38,051	14,220	42,942	14,771
Scarlet fever	12,628	406	16,691	509
Smallpox	375	56	323	36
Typhoid fever	38,518	7,229	42,695	7,732

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for March 27, 1936, pages 349–361. A similar cumulative table will appear in the PUBLIC HEALTH REPORTS to be issued April 24, 1936, and thereafter, at least for the time being, in the issue published on the last Friday of each month.

Cholera

Ceylon.—According to information dated April 7, 1936, 22 cases of cholera were reported among workers in rice fields near Batticaloa, Ceylon. The first case was reported on April 4.

Plague

Peru.—Two cases of plague, with two deaths, were reported in Callao, Peru, during February 1936.

United States—California.—A report of a plague-infected ground squirrel in Ventura County, Calif., appears in this issue of the PUBLIC HEALTH REPORTS, page 486.

Smallpox

Japan—Osaka.—During the week ended March 21, 1936, 5 imported cases of smallpox were reported in Osaka, Japan.

Yellow Fever

Gold Coast—Kumasi.—During the week ended March 28, 1936, one case of yellow fever was reported in Kumasi, Gold Coast.

Ivory Coast—Vavua.—During the week ended April 4, 1936, one case of yellow fever, with one death, was reported in Vavua, Ivory Coast.

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